THE EFFECTS OF AN INTEGRATED TELEMEDICINE IMPLEMENTATION: EARLY RESULTS FROM AN ACUTE CARE AND SKILLED NURSING PILOT PROGRAM

by
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ABSTRACT

Theory: In 2014, the state of Maryland established a new hospital payment model, Global Budget Revenue, which altered the hospital financial incentive structure from volume-based to value-based. This fostered collaboration across the care continuum to reduce preventable hospital utilization. In Harford County, Upper Chesapeake Health and Lorien Healthcare developed a 24-month telemedicine pilot that virtually connected decompensating patients in a continuing care facility (Lorien) with Emergency Department physicians at the hospital. This study examines the impact of the telemedicine program and its individual components on transfers from Lorien to the hospital.

Methods: Patient population factors including age, gender, and ethnicity and care features including time of day and day of week were evaluated to determine the characteristics of patients that had telemedicine evaluations. Additionally, the components of the telemedicine program were evaluated to understand any associations with hospital utilization. Cost saving estimates from reductions in patient transfers and payer savings for avoided ambulance transports were also calculated. Observed changes in quality and financial improvements resulting from the telemedicine implementation may be applicable to other regions of the state.

Results: The rate of hospital transfer from Lorien decreased by at least 15% in each of the program years. The odds of remaining at Lorien were 13 times higher for patients that received a lab test compared to those that did not during the telemedicine episode. In addition, the odds of remaining at the facility decreased by 91% for patients that had the

video evaluation. During the pilot program the hospital is estimated to have saved nearly $85,000 in variable costs and the payers saved $130,000 in avoided ambulance trip reimbursement.

Conclusions: A comprehensive telemedicine program that includes video calls with clinical diagnostic and treatment components like labs, continuous patient monitoring, and medications consistent with those available at the hospital, can reduce the rate of transfers from continuing care facilities to acute care hospitals. Health care leaders seeking to deploy this innovative technology should consider the ancillary components of the intervention as critical aspects of a program that would support higher quality and lower cost under emerging payment models.

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List of Abbreviations

ACO: Accountable Care Organization
APM: Alternative Payment Models
APPS: Computer Applications for Mobile Devices
BMP: Basic Metabolic Panel Lab Test
BP: Bundled Payment
CCF: Continuing Care Facility
CDC: Center for Disease Control
Chem7: Metabolic Lab Test
CHF: Congestive Heart Failure
CLIA: Clinical Laboratory Improvement Amendments of 1988
CMS: Centers for Medicare and Medicaid Services
CNA: Certified Nursing Assistant
DM: Diabetes Mellitus
ED: Emergency Department
EKG: Electrocardiogram
EMR: Electronic Medical Record
EMS: Emergency Medical Services
E&M: Evaluation and Management Coding
FFS: Fee-for-service Billing
GBR: Global Budget Reimbursement
HCT: Hematocrit Lab Test
HH: Home Health
HSCRC: Health Services Cost Review Commission
ICU: Intensive Care Unit
INR: International Normalized Ratio
IV: Intravenous Route of Medication Delivery
LTC: Long Term Care
MEMN: Maryland Emergency Medicine Network
PAU: Potentially Avoidable Utilization
PO: Oral Route of Medication Delivery
POC: Point of Care Lab Testing
RPP: Resources/Processes/Priorities
SNF: Skilled Nursing Facility
TCOC: Total Cost of Care
UA: Urine Analysis
UM UCH: University of Maryland Upper Chesapeake Health

CHAPTER ONE:
INTRODUCTION & STATEMENT OF THE PROBLEM

The Maryland health care delivery system is entering the age of enlightenment. Richer and timelier health information is aiding the transformation of the system from volume-based to value-based care that achieves the Triple Aim of better health, better care and lower cost. Health care leaders are quantifying unnecessary care and conditions that could be addressed in locations other than the costly acute care hospital. Hospital systems in Maryland are now incentivized to reduce avoidable utilization via the new all-payer payment system that includes Global Budget Revenue (GBR). Success under the GBR requires partnership with organizations along the care continuum to ensure efficient care that meets the needs of the patient.

One care setting that has gained particular attention is the skilled nursing facility (SNF), which receives admissions from acute care hospitals, and is a source of readmissions to hospitals. The Centers for Medicare and Medicaid (CMS) report that more than one in six hospital admissions result in a readmission within 30 days of discharge (Medicare Payment Advisory Commission 2007). Further, one quarter of the Medicare patients transferred from the acute care setting to a SNF were readmitted within 30 days. Many of the conditions for which patients are transferred back to the Emergency Department can be addressed within the scope of the nursing home license (Levinson 2013). Reducing readmissions from SNF's represents an opportunity to reduce preventable utilization and reduce unnecessary health care spending by improving the coordination of care across this segment of the continuum.

The University of Maryland Upper Chesapeake Health (UM UCH) and Lorien Healthcare (Lorien) are introducing a telemedicine pilot program to Harford County, Maryland that attempts to address the issue of readmissions and transfers from a continuing care facility (CCF) to an acute care hospital. The program extends the physician expertise in the Emergency Department to the SNF through the use of two-way teleconferencing. Additionally, the telemedicine system introduces point of care (POC) lab testing that aids in treatment decision-making that can result in a new course of care for the patient without the trip back to the hospital.

STUDY AIMS

This study will examine the benefits of deploying the comprehensive telemedicine system in the skilled nursing setting and the resulting impact on readmissions, acute care hospital transfers and Emergency Department transfers. Financial impacts in terms of cost savings for hospitals under the GBR and reduction in charges to insurance companies will be quantified. In addition, the clinical conditions that are positively impacted by these new capabilities will be explored to understand the impact of the video evaluation, POC, and nursing skills in the SNF that are contributing to reductions in transfers.

The study aims to contribute new knowledge to the health care field in the use of telemedicine to reduce unnecessary hospital utilization. There is limited research on the deployment of telemedicine systems to connect skilled nursing facilities with on-demand Emergency Department physician expertise. One study in Massachusetts concluded that the use of a two-way video system to connect patients with a provider team after hours

reduced hospitalizations and saved Medicare more than $120,000 annually per nursing home (Grabowski and O'Malley 2014). This application of the telemedicine system appears to be limited to the use of the video call and the 24-hour offsite provider team.

The UM UCH-Lorien program is a comprehensive program defined as having diagnostic capabilities including point of care labs, ultra sound imaging, continuous patient monitoring and two-way video that connects the patient with the Emergency Department physician whom they would see if they were transferred to the hospital. Preliminary data also suggest that these capabilities are utilized by both the ED physician and the SNF clinical team to evaluate and change care plans as well as by the skilled nursing facility attending physicians who may or may not be on-site.

In general, the data appear to show a reduction in hospital utilization for SNF patients in the year of the intervention's implementation at Lorien. However certain questions remain, including the role that this technology program has played in the reduced hospital activity. Do the non-video components of the program allow the skilled nursing facility providers- both physicians and nurses- to work at the top of their clinical skills and address the needs of patients without a costly transfer to the hospital? Is the connection to the ED the primary driver of the preliminary reduction in readmissions or has the SNF attending been empowered to address changes in patient condition with newly available clinical lab and vital sign data? Stated differently, if the ED provider was unavailable, would the Lorien attending, even if not on site, be able to address the rising patient need based purely on the lab, medication and monitoring capabilities?

Another important question for this study pertains to the mechanism of savings for CMS under Maryland's changing all-payer system. Under global budgets, payers may not directly benefit from hospital admission reductions because lower utilization in the hospital often results in higher unit costs for the patients that are admitted. Currently Medicare does not reimburse for telemedicine evaluation unless the patient is in a medically underserved or rural area (Horton, Malcarney et al. 2014). Does the deployment of telemedicine systems such as this program support the pursuit of new reimbursement arrangements such as bundled payments, which would result in ongoing savings for CMS, through the collective efforts of hospitals, SNFs, providers and payers?

SIGNIFICANCE

Despite a newfound emphasis on the Triple Aim in the U.S., there are limited studies that show the deployment of comprehensive telemedicine programs in skilled nursing facilities. This is in spite of the fact that one in five transfers back to an acute care facility occurs within six days of SNF admission and 10 percent occur within the first 48 hours (Ouslander, Naharci et al. 2016). The costs associated with these readmissions can be significant and more than 20 percent of this activity is categorized as avoidable by staff (Ouslander, Naharci et al. 2016) and up to 68% avoidable by expert panels. (Saliba et.al 2000). These cases are commonly classified as avoidable if the team determines that the transfer may have been unnecessary with earlier identification of the problem, it is within the scope of the SNF to treat, or if advanced care planning, initiated earlier in the patient's stay, may have resulted in fewer transfers based on patient or family wishes.

Many hospital organizations, such as Montefiore Medical Center in New York have collaborated with local SNFs to implement education programs and materials to impact readmissions (Montefiore 2014) as part of their population health strategies. Other tools have been deployed in the acute care setting, such as project RED – Reengineering Discharge, that better address some of the causes of readmissions and ED recidivism (AHRQ 2014). Interestingly, none of the seven organizations currently participating in Medicare's Initiative to Reduce Hospitalizations among Nursing Facility Residents-Payment Model are deploying telemedicine as the strategy to impact this issue (Ingber 2015). Education and hospital discharge reengineering programs do not bring the SNFs' clinical capabilities up to the level of their license. Patients that have a medical need based on a change in condition may require additional care that could be provided entirely within the scope of a SNF if the proper diagnostic tools were in place.

Another important consideration for jointly implementing a telemedicine program is the looming change in Medicare reimbursement. Medicare set aggressive targets to tie 50% of Fee-for-service (FFS) payments to Alternative Payment Models, including Accountable Care Organizations and Bundled Payments programs by 2018, with 90% of all payments including some value component. Skilled nursing facilities and the physicians that provide care within this setting will likely be moving to value-based payments in the near future (CMS 2015). The telemedicine program can serve as an important collaborative step toward success under both the current GBR and the coming alternative payment programs.

Finally, the population of the United States is aging rapidly which drives the need for additional health services in the future. Between 2015 and 2025, the US Census Bureau estimates an increase in the Medicare-aged population, those aged 65 or greater, from 14.8% of the total population to 18.8%, which represents a 27% increase. Additionally, the population of those aged 80 or greater will increase by more than 18% over the same time period (US Census Bureau 2012). This is critical, as Medicare data as of 2011 shows per capita spending increasing from $5,562 to $16,145 between age 65 and age 96. (Neuman 2015). By 2035, the percentage of Medicare patients aged 80 or more is expected to increase from the current 25.4% of the total population of people aged 65 or greater to 30.5%. These trends make it critical to assess opportunities to enhance coordination across the care continuum focused on this portion of the population and to develop programs such as telemedicine that limit unnecessary hospital utilization and the associated expenditures.

CHAPTER 2
LITERATURE REVIEW

Literature on Telemedicine and Current Applications

Telemedicine is defined by the American Telemedicine Association as, "… the use of medical information exchanged from one site to another via electronic communications to improve a patient's clinical health status" (ATA 2012). Recently, telemedicine systems have evolved to address specific needs along the care continuum. The emergence of smart phones and wearable technology has enabled the exchange of patient collected data through mobile applications (APPs) and Bluetooth-enabled activity trackers. This information is typically shared with a primary care provider to give insight to the patient's ongoing weight or blood pressure management. This information is helpful for determining the patient's ability to manage chronic diseases such as Congestive Heart Failure or Diabetes.

Beyond capturing foundational data, health systems and payers alike have deployed programs such as Electronic Medical Record (EMR) patient portals that allow patient-initiated questions to be routed to providers for follow up (Cahill, Gilbert et al. 2014). This is akin to a secure email system that can become part of the ongoing medical record. These patient questions may trigger the need for a future appointment. However, the ability to share information between the patient and provider through this secure portal may support and enable better self-care and eliminate the need for, and expense of, an in-person visit.

A more clinically integrated use for telemedicine is the virtual Intensive Care Unit. These systems are typically deployed in more remote settings where it would be difficult to staff critical care providers due to smaller patient volumes. A care team at the smaller hospital has physician coverage provided via a linked two-way video system with telemetry and medical records available to the intensivist located off-site. Virtual ICU programs have improved patient outcomes and have spread to 223 hospitals by 2010 (Kahn, Cicero et al. 2014). Additional hospital-based uses of telemedicine include the remote reading of imagining studies where a radiologist may be offsite reading studies for multiple hospitals from a central work station. Remote monitoring tools, such as 12-lead EKGs, have been deployed in Emergency Medical Services (EMS) ambulances connected to the hospital as a way to rapidly diagnose heart conditions such as myocardial infarctions (Dhruva, Abdelhadi et al. 2007).

Gradually, primary care providers have been utilizing telemedicine systems to extend the availability of care to the elderly. One such program used a telemedicine system to connect primary care providers and patients virtually for routine check-ups at an assisted living facility, which typically offered only basic levels of care. The telemedicine program also offered the option to render a more intensive evaluation if the patient had a more acute need (Gillespie, Shah et al. 2016). This program prevented unnecessary trips to the Emergency Department for patients that resided at facilities that were highly engaged in the telemedicine program. Additional primary care related telemedicine services for purposes of conducting specialty consults, such as dermatologic care, are emerging (Okita, Tinoco et al. 2016).

Literature on Financial Barriers to Telemedicine Utilization

One significant factor for the broader adoption of telemedicine service is the reimbursement available to physicians that provide the service. Depending on state policy, providers may receive revenue for remote monitoring of vital signs, "store and forward" services such as radiology, and live video evaluation. Other policies may differentiate payment for those that transmit the data versus those that receive the data. State and federal regulations dictate if any payment is available for providers based on geography (Adler-Milstein, Kvedar et al. 2014).

Since many of the patients receiving care in Skilled Nursing Facilities qualify for Medicare coverage, it is important to examine the CMS policy on the use of telemedicine. From 2001 to 2012, Medicare had only increased spending on telemedicine services from $61,000 to approximately $6 million (OIG 2018, Lustig 2012). This can, in part, be explained by the constraints placed on telemedicine reimbursement as part of the Medicare, Medicaid and SCHIP Benefits Improvement and Protection Act of 2000 that limits payment to activities provided in specific geographic areas considered non metropolitan, in a designated rural health professional shortage area, or as part of the Federal Telemedicine Demonstration Project (Horton, Malcarney et al. 2014). A 2015 Medicare audit indicated that 31% of paid claims for telemedicine services did not meet the criteria for reimbursement resulting in a $3.7 million overpayment. More than three quarters of the overpayment was due to the encounter not originating in an approved area. In 2018, Medicare still only provides payment to providers that conduct two-way video

calls to prevent readmissions from SNFs if the facility in which the patient resides is located in a rural or medically underserved location.

Due to these limitations, Maryland Medicare activity for telemedicine in 2012 totaled just 243 encounters and less than $5,500 paid (Neufeld and Doarn 2015). A national survey of telemedicine utilization completed by providers revealed States that expanded payment for telemedicine services to non-Medicare payers increased the use of telemedicine for Medicare beneficiaries (Neufeld, Doarn et al. 2016). However, these services are often not billed by the provider, or are denied payment by Medicare. Private payers are also highly influenced by Medicare policy, thus "elimination of the disparities in federal and state public policy for reimbursement for services delivered via telemedicine would probably encourage more private payers to change their internal policies…(Antoniotti 2014)." A study reviewing the potential to expand telestroke programs indicated that the geographic restrictions placed on reimbursement by Medicare led to a payment that was 2.6% less than the cost of providing the service, in effect, slowing the broader use of this option to care for patients (Aita, Nguyen et al. 2013).

Reimbursement schedules can serve as a tangible motivating factor for physicians when determining whether to provide the telemedicine service or not. Standard evaluation and management (E&M) codes govern the amount of provider payment based on the intensity of the service for each encounter. For example, an E&M code that ends in a "1" is considered less intensive and thus is reimbursed at a lower level. The more intensive the service is deemed, the higher the ending number, with the maximum intensity ending in a "5." For example, the code ending in a 1 may require a history of

present illness, the code ending in a 5 will require the history *and* a "comprehensive exam- either a general multisystem exam or a complete single-organ system exam." (Weida 2008) As the thoroughness of the examination increases, the amount of reimbursement also increases. The very nature of the telemedicine program precludes a provider from billing for the highest reimbursement codes because the physical exam cannot be completed. It follows then, that a busy ED physician faced with a choice of seeing a sick patient in person or an equally ill person remotely would prioritize the patient that is physically present in the ED. After all, the time spent with both patients would be approximately the same, but the payment for that time would be greater with the ED patient. In this case, the provider is actually incentivized to have the patient transferred so that the highest possible reimbursement code can be used to obtain the highest possible reimbursement. A 2014 survey by the American Academy of Family Physicians found that while more than two thirds of providers felt that telemedicine improves continuity of care, only 15% actually used telemedicine in the prior year. Reimbursement was a significant barrier cited by 53% of respondents (Moore, Coffman et al. 2016).

Another important financial barrier to broader adoption of telemedicine programs that link acute care and continuing care settings results from the differences in coverage and payment between Medicare and Medicaid programs. These differences are subtle but provide a substantive disincentive for preventing acute care readmissions in dual eligible patients in a continuing care facility (CCF), which includes both long-term care and skilled nursing. Dually eligible long-term care patients have services covered through Medicaid with a lower reimbursement schedule. If a LTC patient moves to the acute care

setting and then returns to the CCF, it is likely that the patient will first spend some time in the CCF skilled nursing unit with insurance coverage provided by Medicare. In this case, the facility gains a higher reimbursement from Medicare and the Medicaid program avoids having to pay for these days. These coverage and payment model differences between Medicare and Medicaid contributes to a misalignment wherein "Medicaid has less incentive to enact policies discouraging transfers from long-term to acute care settings" (Grabowski 2007)

The Maryland state Medicare waiver places an emphasis on managing the total cost of care, regardless of the setting and includes post-acute spending. If growth in total cost of care in Maryland is greater than the national Medicare growth rate, the Centers for Medicare and Medicaid may amend or revoke the waiver. As a result, the Health Services Cost Review Commission must act to keep the state in a "safe zone". These actions may include limiting future annual rate increases for hospitals operating under the Global Budget Revenue (GBR) program. In such cases, the hospital is penalized, in effect, for growth of the non-hospital expenses that are component costs of the total cost of care. By using a telemedicine program as part of the continuum of care, hospital visits may be avoided altogether, and or the cost of acute hospitalization and subsequent skilled nursing stays may be minimized. As a result, there is alignment between the state regulator and the hospitals to work with continuing care facilities and limit unnecessary acute care volume. However, the incentives for the long-term care, skilled nursing facilities, and physicians remain unchanged, thus creating a challenge in garnering the cooperation necessary to implement telemedicine programs.

Literature on Clinical Barriers to Telemedicine Utilization

Clinical variation is another key barrier to developing a telemedicine program with partners operating in different sectors of the care continuum. Clinical experts using medical records to review SNF readmissions have previously noted that as many as 68% of these cases are avoidable. (Saliba 2000, Ouslander 2010, Vasileuskis 2017). The telemedicine program may be a useful tool in preventing this otherwise avoidable utilization. A foundational element of a program that spans two facilities is agreement on the clinical criteria under which patients will or will not receive the telemedicine services for evaluation and management of their condition. Blood pressure, pulse oximetry, etc. can be objectively measured, allowing clinicians to follow an approved algorithm for patient care.

Even with consensus on a protocol, it is possible that patients do not fit squarely within these agreed upon parameters or that medical experts may disagree on the patient's candidacy for this intervention. A patient's baseline status at a continuing care facility, such as a consistently low blood pressure, may permanently place them outside of the guideline for initiating telemedicine. Where a SNF provider may find that the low blood pressure value is ancillary to the reason for a change in condition, an acute care provider may find that detail as contributing to the issue. Vasileuskis examined potentially avoidable readmissions from SNFs and found that "the factors identified as contributing to the readmissions often differed between hospital and SNF reviewers" (Vasileuskis #1). The hospital case reviewer found the readmission to be avoidable 30%

of the time, while the SNF reviewer only 13%. Clinicians may find that the clinical criteria are too restrictive or too broad, leading to over use or underuse of the system.

Operationally, the decision to use telemedicine may be influenced by non-physicians at the SNF. "Certified nursing assistants may be the first caregivers to identify a change in resident status, thereby initiating a chain of events leading to hospital transfer." (Lamb 2011) Ideally, a telemedicine program would create an alternative path for SNF caregivers to pursue while keeping the patient at the facility. Given that the SNF physician is not required to see the patient daily, non-physician caregivers often have the most knowledge of the patient, which can create circumstances in which the SNF physician defers to the Certified Nurse Assistant (CNA) at the SNF. Once a telemedicine program is introduced to the care process, a hospital physician becomes part of the equation, creating opportunities for clinical disagreement among non-peers. In the midst of the telemedicine encounter, the ED provider relies on the adherence to the agreed upon criteria to minimize risk for the patient and legal risk for the provider. Finding the proper balance of clinical criteria can empower non-physician care givers at the SNF, while instilling confidence in the acute providers that the patient on the other end of the telemedicine call can benefit from their decision-making.

Leadership Implications

Implementation of a telemedicine program requires a commitment on the part of leadership to overcome the challenges associated with deploying an innovative process that is disruptive to the current work streams of each of the participating organizations. It requires a long-term commitment of time, energy, and personal and political capital to

assure not only successful implementation, but also successful day-to-day performance over time. Ancona and Gregersen noted in their study of the Massachusetts Institute of Technology leadership development, that the successful MIT teams, "…don't follow leaders, they follow problems…" They further observe that "the most significant work, then, of what we would call the 'leader' in a situation is to seize on some intriguing, inspiring, barely-solvable problem, and frame it in a way that draws other smart and skilled people toward it." (Anconoa and Gregersen 2018) The organizational structures of most healthcare facilities do not encourage this level of issue promotion and attraction. The formal leaders of facilities are more likely to pinpoint the problem with limited input from frontline staff, then explore a solution while mandating a successful implementation. Healthcare organizations that endeavor to become more innovative need to create a climate in which all members of the organization can participate in problem identification and solving with alacrity.

At the core, solving the issue of SNF-hospital readmissions with a telemedicine program is a change management project requiring leadership from all levels of the three organizations, Lorien, MEMN, and UM UCH, which all need to offer technical expertise and develop a shared vision or culture. MEMN and UM UCH have overlapping incentives and cultures due to the nature of their contractual relationship – MEMN provides ED physicians to work at both of the UM UCH Emergency Departments. Even though they are not always in financial alignment, the clinical priorities of MEMN and UM UCH are coordinated, particularly since MEMN providers work side-by-side with their non-physician counterparts in the UM UCH ED. Lorien Bel Air, on the other hand, is literally and figuratively isolated from the culture of MEMN and UM UCH by

geography as well as clinical licensure and practices. “Organizational culture is a dominant factor [in developing the value-added capabilities], as it is both a set of rules that determine the actions of an individual or a group and it is also a reflection of the core elements of an organization.” (Connor 2013) Aligning multiple cultures, or reconciling core elements, without proper incentives can be a great challenge for health systems facing unwavering pressure to perform in the current delivery system.

In his book Organizational Culture and Leadership, Edgar Schein concludes that, "... culture is a property of an independently defined social unit – a unit whose members share a significant number of common experiences in successfully addressing external and internal problems." Since this is a new telemedicine program, and the first significant collaboration among the parties, the partners cannot rely on shared experiences to guide future problem solving. To address this deficiency, leaders from each organization created a telemedicine planning environment where shared clinical and operational values could develop organically over time. The culture will materialize fully only when the three groups are working collectively with actual patients using the system and processes.

Renowned innovation scholar Clayton Christensen and his colleagues developed a helpful framework to understand how culture can drive capability. The RPP framework identifies Resources, Process and Priorities as the most important factors that drive organizational aptitude (Christensen 2008). Each of the pilot program participants, Lorien, MEMN, and UM UCH have assigned critical clinical resources (Clayton’s “R”) to develop and implement this innovative program. Certain fundamental resources, such

as staff training, and reliable physician availability must be in place. The leadership teams are willing to create new processes (Clayton's first "P") for telemedicine and have allowed key stakeholders to allocate time to developing the necessary workflow to provide safe care of patients.

Remote evaluation of a vulnerable patient at a SNF is a significant shift in workflow for all three organizations. Ronald Heifetz and his colleagues identified a framework to mobilize people called adaptive leadership, a change management process that often includes the need for new learning. He notes that, "…adaptive work is required when our deeply held beliefs are challenged, when the values that made us successful become less relevant, and when legitimate yet competing perspectives emerge." (Heifetz 2001) This competing perspective – to drive avoidable hospital utilization out of the health care system- first emerged at the hospital when the reimbursement model shifted to GBR. This perspective is less obvious or even unimaginable to the SNF team and the ED providers that continue primarily with fee-for-service payments. Heifetz continues, "…adaptive change is distressing for the people going through it. They need to take on new roles, new relationships, new values, new behaviors, and new approaches to work." (Heifetz 2001) This is particularly true when the required change spans multiple business entities and geographic locations. When O'Malley, and his colleagues examined the process of changing the manner in which a physician group provided medical coverage to a SNF, they observed that the providers needed to come to consensus about a new practice model, or that change would not occur. "This is particularly true because addressing SNF utilization requires changes in physician and nurse workloads, schedules and income." (O'Malley 1999cms 2000) As a result, leadership must educate teams about

new priorities, clearly define roles along the process and nurture new relationships among the participants to drive consensus.

Heifetz further notes that adaptive change contains a "sustained period of disequilibrium," which will require an ongoing commitment from leadership to back the clinical team. (Heifetz 2009) Turning the phrase from Jim Collins, taking the telemedicine program from "good" to "great" will require what he calls, Level 5 leadership. A Level 5 leader, or program champion, "…Builds enduring greatness through a paradoxical combination of personal humility and professional will." (Collins 2005) This means that leadership from each organization must provide unwavering support throughout the pilot phase and beyond. The teams will encounter difficulties during the implementation of a telemedicine program, but leadership must provide the resources to overcome these people, process or technology issues without second-guessing the vision to provide high quality care without the transfer to the hospital. In addition, as Collins notes, humble leaders will assign credit for a successful deployment of telemedicine to the frontline staff, subtlety allowing the team to assume ownership of the program over time.

The teams are merging priorities (Clayton's second "P") at the macro level through the development of a shared culture and alignment of financial incentives. However, leadership cannot completely control the priorities and motivations of front-line team members, which can make it difficult to achieve the full potential of the telemedicine program. In some circumstances, the program priorities may be vulnerable to individual behavior. For example, a nurse at Lorien may find it easier to by-pass the

telemedicine program and transfer a sick patient directly back to UM UCH if it also means that she will get a break from the patient's difficult family. MEMN may prioritize a direct patient transfer without remote evaluation because the ED is congested, and the designated physician does not feel she has the time to stop and answer the telemedicine call. Moving from development to implementation, Lorien, MEMN and UM UCH must continually monitor the daily operational factors that can inhibit the teams' ability to keep priorities aligned. Frequent and focused communication can foster continued alignment of priorities and values among the participants and drive success from the perspective of patients and families as well as the healthcare organizations. John Kotter notes in his article, *What Leaders Really Do*, "Good leaders motivate people in a variety of ways. First they always articulate the organization's vision in a manner that stresses the values of the audience they are addressing...this gives people a sense of control." (Kotter 2001) To provide Kotter's control, leadership must minimize the aspects of telemedicine that might generate fear among staffers and parse out new tasks over time. If the telemedicine program threatens a team member's daily work, control, in the eye of frontline staffers, may be lost.

Clearly, not only the sophistication of the technology, but also the commitment and attitudes of the work force, the environment of capabilities, and the culture of the participating organizations influence success in the move to telemedicine. Beyond these organizations, telemedicine program expansion also requires leadership from the policy makers that can determine payment models to align the incentives of all parties. In fact, the commitment of leaders to bring all constituents together in a shared vision and to provide the necessary resources is paramount if the move is to be successful both now

and in the future. Without this critical leadership, disruptive innovation will be difficult to sustain.

Literature on Cost Savings Associated with Telemedicine

There is limited literature on the cost savings and hospital cost avoidance associated with the joint implementation of a telemedicine program at the acute care and skilled nursing settings. Some programs have been deployed in alternative post-acute locations such as Long-Term Care (LTC) or at home with Home Health nursing support. At the Tampa VA, a 2013 telemedicine program for Congestive Heart Failure patients reduced readmissions and achieved a cost saving compared to the CHF patients in 2012 at the Tampa VA (Messina 2016). A cost effective telemedicine-based chronic wound care clinic deployed in the Long Term Care setting resulted in a cost savings of $90 per consultation compared to an in-person consultation occurring after the patient was transferred to an acute care facility (Specht, Wakefield et al. 2001). Improved quality associated reductions in readmissions or better control of chronic conditions with these telemedicine applications benefits the patient, while any savings associated with reduced utilization accrues to the payer. Under the Maryland GBR model, however, this financial benefit is realized by the hospital in the short term and ideally the payer and other stakeholders over the long term.

Another aspect of savings that can benefit the hospital results from the reduction of expenses associated with sending staff to patients that are geographically dispersed. In Queensland, Australia, the hospital system established a Cancer Care telemedicine program that limited the need for patients and specialists to travel to and from the satellite

locations. In the 56-month evaluation period, the hospital netted more than $320,000 of savings (Thaker, Monypenny et al. 2013).

These innovative telemedicine approaches operate in environments that are not directly comparable to Maryland. The programs occurred in locations other than the SNF or without the payment incentives of the GBR. There is one study, however, that is a close parallel. A for-profit nursing home chain in Massachusetts found that a SNF with an average of 180 annual hospitalizations could see an average reduction of 15.1 hospitalizations per year with a telemedicine program (Grabowski and O'Malley 2014). This program connected patients to a telemedicine team for after-hours care when their primary care provider was not available. The study does not, however, specify if the two-way video call was supported by point of care testing or vital sign monitoring, making it difficult to directly compare this intervention to the UM UCH – Lorien pilot program.

Literature on CLIA and CLIA Waiver Labs

A major component of clinical decision-making is laboratory tests. A 2010 review of 200 hospitalizations from nursing homes in Georgia identified 67% as being potentially avoidable. A major contributing factor for the hospital transfer was the unavailability of lab results within three hours. (Ouslander & Lamb 2010) The UM UCH-Lorien pilot program included the availability of six tests completed within the Lorien setting to aid in the assessment of common clinical issues. These tests included: White Blood Cell (WBC), Hemoglobin (Hb), Hematocrit (HCT), Basic Metabolic Panel (BMP or Chem7), International Normalized Ratio (INR), and routine Urine Analysis (UA).

Deployment of this laboratory capability is complex due to the regulations that govern "sites that test human specimens for health assessment or to diagnose, prevent, or treat disease." (CDC 2014).

The rules, enabled as the Clinical Laboratory Improvement Amendments (CLIA) statute by Congress in 1988, allow for facilities to execute tests depending on the test's categorization of low, moderate or high complexity. For moderate or high complexity tests, the regulations dictate that significant processes for oversight and quality assurance be in place, including responsibility for the oversight of the program and staff by a pathologist or a physician with significant pathology training (AAFP 2016). As part of the integrated telemedicine program, this requirement creates an extra level of coordination among the partnering organizations as WBC is considered a High Complexity test. (FDA 2016) The WBC test is used to help clinicians determine if an infection is present and what clinical response is best suited for the patient. Due to the high incremental cost of adding a pathologist to the SNF payroll, and without new incremental revenue, it may not be financially possible for the SNFs to add this level of physician oversight. This in turn limits the availability of this test to be completed as a point of care offering and restricts the volume of patients that may be served by the telemedicine program. The other five tests identified as part of the pilot program are considered low complexity and therefore qualify as CLIA "waived" at the site. Although the "Food and Drug Administration (FDA) determines the criteria for tests being "simple with a low risk of error," the regulations still require the facility to enroll in the CLIA program, follow the manufacturers' guidelines and be subject to random inspections for waived testing. (CMS 2000)

Literature Review Summary

Telemedicine applications have successfully been deployed across the continuum of care with a potential for greater use in the future. Current "store and forward" capabilities are being augmented by emerging technology that allows for real-time sharing of continuous monitoring and two-way video calling for remote evaluation and management of patients in a variety of settings. Existing deployments of telemedicine systems have resulted in reduced hospital utilization and the associated costs. A significant barrier for the broader adoption of these programs is the financial incentive for organizations and providers to embark on a program that may affect their business model, hospital market share, and/or provider reimbursement. In Maryland, the GBR begins to pull providers into alignment such that a robust telemedicine program with a skilled nursing facility, already shown to provide benefit to patients, may be deployed. Clinical consensus on the protocol that governs telemedicine must consider the baseline status of the patient and while recognizing the caregiver with the most knowledge of the patient. Integrated leadership is required to ensure that resources, processes and priorities drive sustained success. As insurance coverage for patients may be as complex as their disease state, the GBR creates an imperative for hospitals in Maryland to identify cost efficiencies that supersede current insurance coverage and current reimbursement models to allow for innovation with telemedicine outside of rural or medically underserved areas.

CHAPTER 3
METHODS

Description of the Intervention: The Telemedicine Pilot Program

Under the Maryland Global Budget Revenue payment system, hospitals are directly incentivized to reduce unnecessary utilization including readmissions. UM UCH and Lorien collaborated on a comprehensive telemedicine pilot that aimed to reduce readmissions, acute care hospital transfers and Emergency Department visits.

The telemedicine process was jointly developed by leaders of Lorien Health, University of Maryland Upper Chesapeake Health (UM UCH) and the Maryland Emergency Medicine Network (MEMN). Lorien is a continuing care facility located approximately two miles from Upper Chesapeake Health's Upper Chesapeake Medical Center (UCMC), which has 69 skilled nursing/ long-term care beds and 56 assisted living apartments (Lorien 2016). The skilled beds are frequently filled to capacity and primarily occupied by patients aged 80 or greater. During the pilot program 61% of the residents were at least 80 years of age and a full 90% were insured by Medicare or Medicaid or a combination of the two.

Upper Chesapeake Medical Center is an acute care hospital with 183 licensed beds. The Medical Center contracts with the MEMN physician group to provide emergency services covering the 63,000 annual ED visits. The hospital admits more than 18,800 patients as either an inpatient or in an observation status (UCMC). During the first 12 months of the pilot period, 509 patients discharged from UCMC were admitted to a skilled nursing facility and readmitted to an acute care hospital within 30 days.

The telemedicine program was initiated on December 1st, 2014 and continued through November 30th, 2016. During this pilot, there were nine participating MEMN physicians, all board certified in Emergency Medicine. These physicians required specific credentialing by Lorien in order to provide the remote evaluation services. This credentialing process required the completion of a Lorien application, proof of licensure and Medicare participation, and demonstration of malpractice insurance coverage. After the information was gathered from the ED providers via the UM UCH medical staff office, it was reviewed by the Lorien Bel Air site Administrator and Medical Director for approval. The process from initiation through completion lasted approximately 60 days. The MEMN providers were assigned to cover specific days of the week and shifts as necessary. The physicians were also trained on the telemedicine system and provided a laptop that allowed the MEMN staff to conduct two-way video calls and view patient monitoring data in the LifeBot telemedicine system, 24 hours per day.

Providers relied on a mutually agreed upon clinical workflow to govern the use of the telemedicine components and make determinations about the patient's ability to remain at the facility, Once a change in the patient's clinical status is identified, the Lorien nurse may initiate the telemedicine process that in part determines if the patient will be evaluated by on-site or on-call providers or by the ED provider via the two-way video call. The patient will be connected to the monitoring system for 12-lead EKG, blood pressure and pulse oximetry. Point of care testing including routine urine analysis, Hematocrit, and white blood cell count may be initiated by nursing based on protocol. In the case of an ED two-way video call, these rapid cycle lab results, plus visual observation and cardiac monitoring equipment, allow ED providers to make diagnosis

decisions that may result in the continuation of the treatment course at Lorien, the initiation of new treatments at Lorien or the transfer of the patient to the hospital.

The ED providers are also able to order medications and IV fluids to be initiated at Lorien. Inventory at Lorien was standardized to be the same as that available within the Emergency Department at Upper Chesapeake Medical Center just two miles away. These medications were selected by the Emergency Department physicians and the leadership team of Lorien to address many of the commonly presenting clinical issues that are appropriate to be treated within the SNF environment. Drugs for cardiac conditions, metabolic syndromes, allergic reactions and respiratory concerns as well as IV antibiotics for infections were all added to the Lorien exam room. In some cases, these medications were already available, but the clinical leadership changed inventory to a higher dose or a different route of delivery e.g. moving from by mouth (PO) to intravenously (IV). If the patient remains at the SNF, subsequent ED video calls and lab tests may be necessary to evaluate the effectiveness of the treatment response. If the patient's condition has not improved and transfer to the hospital's Emergency Department is indicated, the patient may well have benefited from the early initiation of treatment, such as the administration of medication that would likely to be given at the Emergency Department upon arrival.

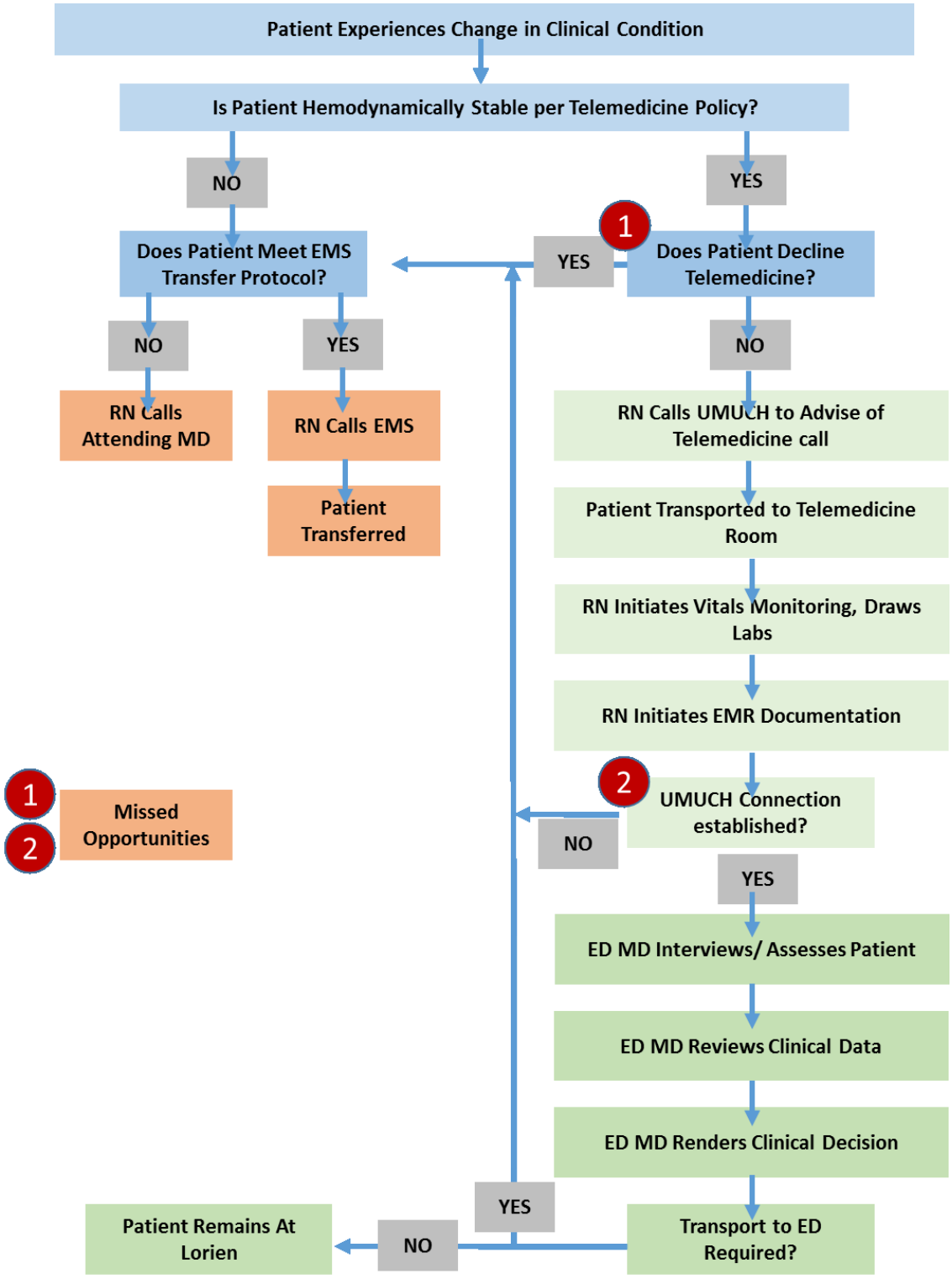
During the implementation of the pilot, leadership from all three participating organizations completed weekly quality assurance calls or conducted in-person meetings. The team was comprised of the Lorien clinical team members including the Chief Operating Officer who is a nurse, the System Vice President of Nursing, the Bel Air site

Director of Nursing and the site Medical Director. The Chair of Emergency Medicine who is also employed as a member of MEMN and the Vice President of Population Health and Clinical Integration from UM UCH were also part of the team. Information technologists from both facilities rounded out the pilot team.

The weekly reviews resulted in several adjustments to the algorithm including a change in the sequencing of notifying the SNF attending provider. The model was refined early in the pilot, because the attending providers at Lorien, when called, would nearly always direct the Lorien nurse to send the patient to the hospital via EMS without any evaluation. A process change was approved by the Lorien Medical Director that would allow the nurse to initiate the telemedicine call with the ED first, then notify the Lorien attending afterward. This resulted in an increase in the use of the system while the Lorien physicians gained comfort with the process. The pilot algorithm is detailed in figure 1 below.

Beyond the discussion of workflow, the pilot team held dialog about "missed opportunities" as part of each review meeting or call. These "missed opportunities" are cases that resulted in a patient's transfer to the hospital with or without the use of the telemedicine program. Any patient that was transferred out of the SNF was discussed. In some instances, the case was clinically appropriate for telemedicine utilization, but other factors influenced the decision to send the patient to the hospital prior to the onsite intervention. Information garnered from reviewing these cases was used to reassess the clinical criteria, for example, to determine if the criteria could be broadened allowing for more patients to be cared for safely.

FIGURE 1. – Telemedicine Process



Preliminary Data

Preliminary data gathered during the first 11 months of the 24-month pilot indicates that the program did affect the number of patients requiring hospital services, particularly those needing evaluation within 30 days of acute care discharge. Table 1 displays metrics associated with the 30-days readmissions to the hospital, including but not limited to UCMC. The data lists the baseline performance period as a 12-month period prior to the initiation of the pilot, shown as October 1st, 2013 through September 30, 2014.

During the prior year baseline period, there were 83 patients that were readmitted as a subset of the 610 patients admitted to the Lorien skilled nursing beds. The Lorien Bel Air facility admitted an average of 50.8 patients per month to their skilled nursing units with 6.9 patients readmitted to an acute care hospital within 30 days in an average month. This represented a 13.6% 30-day readmission rate and served as a benchmark for the pilot team's goal of a 25% reduction using the telemedicine program or a target 30-day readmission rate of 10.2%. The second critical metric shown is for acute care transfers. These are patients that are transferred from the post-acute setting to any acute care hospital at least 30 days since their last acute care hospitalization (outside of the 30-day readmission window). The metric is shown as a rate per 1,000 patient days. A baseline acute care transfer rate of 4.2 per 1,000 patient days was calculated using the monthly average of 8.8 acute care transfers and 2,062 patient days. The target acute care transfer rate of 3.2 per 1,000 patient days was established representing a 25% reduction from baseline. The final measure noted in Table 1 represents patients that were sent from

Lorien skilled nursing or long-term care beds to the hospital Emergency Department that were not admitted upon in-person evaluation. These patients were sent back to the SNF after receiving evaluation and treatment exclusively within the ED at an acute care hospital. Patients that visit the Upper Chesapeake Medical Center Emergency Department and are discharged without an admission spend between 3.9 and 4.2 hours in the ED. The baseline ED transfer rate per 1,000 SNF patient days is shown as 6.8 (monthly average of 14 ED transfers and 2,062 patient days). The target was set at 5.1 ED transfers for every 1,000 SNF patient days, which represents a 25% reduction.

Table 1.

Measure	Numerator/Denominator	Baseline Average/Month Oct. '13 - Sept.'14 (12 Months)	Pilot Period Average/Month Dec. '14 - Oct. '16 (11 Months)
30-Day Readmissions	Number of patients that were admitted from an ACH to Lorien Bel Air and were re-admitted to an ACH within 30 days of hospital discharge date	6.9	5
	Number of patients that were admitted to Lorien Bel Air from an ACH	50.8	53.3
	Percent	13.6%	9.4%
Acute Care Transfers (Outside of 30-Day Readmission Window)	Number of patients that were admitted to Lorien Bel Air from an ACH	8.8	7.7
	Total number of resident days for the month at Lorien Bel Air	2,062	2,094
	Rate per 1,000 patient days	4.2	3.7
ED Revisits	Number of residents that were transferred via ambulance to an ACH	14	11.6
	Total number of resident days for the month at Lorien Bel Air	2,062	2,094
	Rate per 1,000 patient days	6.8	5.6

Preliminary aggregate data suggests a reduction in utilization across each of the utilization categories on average each month. As the pilot program aimed to impact avoidable hospital utilization, the research questions seek to better understand the components of the program that enable such reductions. For example, the early pilot indicated that approximately four of every five uses of the comprehensive telemedicine room resulted in an evaluation with a provider other than the ED physician. The testing and treatment options available in the telemedicine room itself were helpful to a Lorien

attending provider without the need for the two-way video. Further evaluation of the pilot program will be conducted by comparing the observed rates of transfer data from the pilot period to the year prior, and with a similar Lorien facility in Harford County, to determine if the results obtained during the pilot period were related to the intervention as opposed to secular trends. The research aims to refine the definition of telemedicine for this application to differentiate between true interactive remote evaluation and a monitoring tool that allows the SNF team to work within the full capability of their licensure.

Table 2 delineates the occasions when the telemedicine room was utilized while differentiating between the use of the two-way camera for MEMN physician evaluation compared to the times the room was used without the remote video evaluation during the first 11 months of the pilot. Preliminary data shows that over time, the team at Lorien Bel Air was able to use the telemedicine program without the need to connect to UM UCH.

Table 2.

Measure	Dec '14	Jan '15	Feb '15	Mar '15	Apr '15	May '15	Jun '15	Jul '15	Aug '15	Sep '15	Oct '15	Total
UMUCH Cases (Video Call to ED)	1	1	5	1	0	1	0	2	2	1	0	14
Lorien Cases (No Video Call)	1	1	4	8	8	3	9	9	12	10	11	76
Percent No Video Call	50%	50%	44%	89%	100%	75%	100%	82%	86%	91%	100%	84%

Research Objectives and Hypotheses

OBJECTIVE #1 – Quantify hospital utilization impact, and associated variable cost, of telemedicine under the GBR.

HYPOTHESIS #1 – Comprehensive telemedicine reduces acute hospital utilization

It is assumed that combining two-way video calling with biometric monitoring, lab testing and advanced medications in the skilled nursing facility setting allows providers to assess and treat patients at the continuing care facility without the need for costly transfer and admission/readmission. The hospital utilization is defined in terms of 30-day readmissions, acute care transfers outside of the 30-day window from previous acute discharge, and ED visit volumes. Variable costs associated with a reduction in preventable utilization (ED visits or avoided hospital days) have been quantified using a savings calculation provided by the UM UCH finance department.

Future analyses will need to explore the limitations that the GBR may have on saving money for the payer. The GBR requires hospitals to charge the full allocated annual amount which means that avoided case savings could be offset by an incremental increase in the unit cost of the remaining patients. The net effect for the payer may be zero. In a rudimentary example, a hospital with a GBR of $10,000 and 10 patients seen would result in each patient being charged $1,000. By reducing two readmissions via telemedicine, the acute care hospital activity would change as follows: the GBR would remain at $10,000 but spread over only eight patients, each of which would be charged $1,250. Under the GBR, despite the reduction in utilization, the payer would still cover

the same $10,000. As a result, this research will quantify variable hospital cost savings and the cost of avoided ambulance transportation only.

OBJECTIVE #2 – Understand the impacts of the individual components of the comprehensive Telemedicine program.

The two-way video calling provides some patient care benefit, even for patients that need to be transferred to the hospital after initial evaluation. These video calls allow the provider an opportunity to assess and begin some treatment prior to the patient's arrival at the ED decreasing the time to treatment. There are, however, many appropriate uses of the program that do not require this video calling capability. Many patients can be diagnosed and treated exclusively by the team at the SNF using the lab data, patient monitoring equipment such as EKGs and access to newly stocked medications without the need to call the ED. In the absence of two-way video with an Emergency Department provider, would the program still benefit patients, providers and payers?

Conceptual Framework

There are many factors driving the transformation of the US health care system, which is seeking greater value for the dollars invested. Across the continuum, avoidable utilization and more cost-effective care options are being explored to address the needs of patients. The US government serves an interesting role in the health care system transformation driving change as both a regulator and a payer through CMS. Maryland's unique arrangement with CMS has accelerated change through the implementation of Global Budget Revenue that incentivizes hospitals to partner with organizations across the continuum to limit growth in the total cost of care, particularly in care that is

potentially avoidable. Meanwhile, consumer demand for quality and efficient care as well as the expected increase in health services due to the aging population are two factors also influencing the change.

The current delivery and reimbursement systems create silos for the provision of service based on the patient's physical location and their insurance coverage. Unfortunately, disease and health status are not governed by these same regulations. The fact is, patients have needs that can and should be addressed in the right place at the right time regardless of financial incentive or payment structure, including the skilled nursing setting where state licensure would allow for many of the interventions that can prevent a patient from being sent back to the hospital. This is an important area of focus since the use of skilled nursing care, as projected by the CMS Office of the Actuary, is projected to increase 3.9% from 2014 to 2017. A corresponding increase in the case-mix for these patients is estimated to be 7.9%. (CMS 2017 Payment Notice). Skilled nursing facilities will need to consider options by which to expand their capabilities to manage a patient population in which a greater proportion will have higher acuity needs. Telemedicine may offer one such alternative.

Organizations that avail themselves of this type of technology and key supporting infrastructure are hoping to achieve significant benefits from integrated care and increased clinical skill in the SNF setting, leading to improved outcomes. Since the change in a patient's clinical condition may occur at a time when a physician is not on-site at the post-acute location, developing on-demand access to providers in tandem with diagnostic capabilities that aid in decision-making are critical. This research aims to

better understand how patient characteristics, care characteristics and telemedicine intervention components affect hospital utilization. Multiple analyses will allow for better understanding of the relationships, if any, of certain variables on outcomes. At a facility level, individual patient characteristics such as age, gender, and clinical condition as well as care characteristics like time of day and day of week of the telemedicine use, will serve as important independent variables. These variables may influence which of the individual telemedicine components, as dependent variables, are deployed during an encounter.

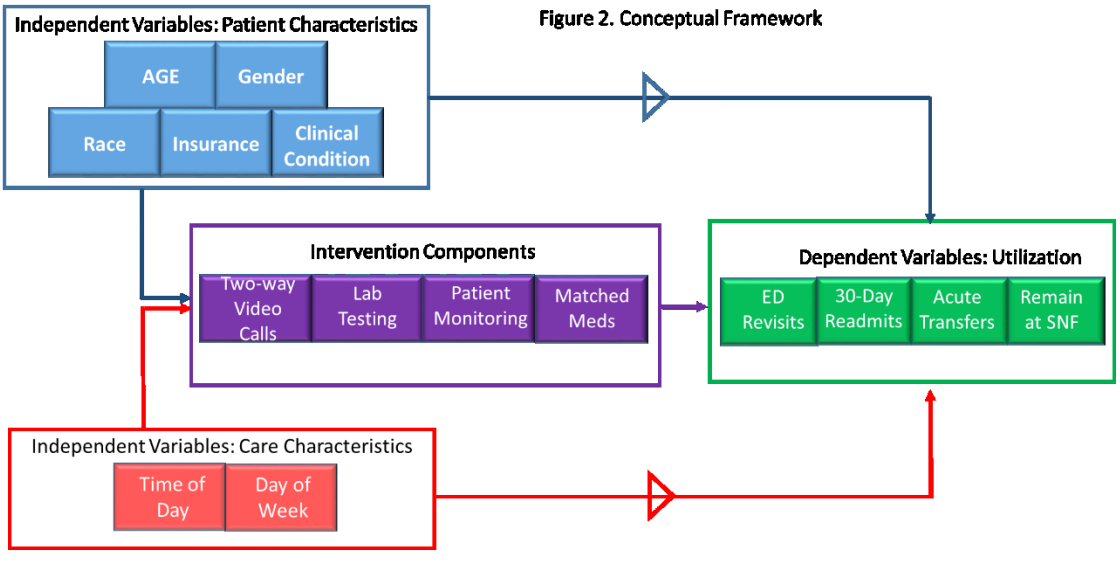
The intervention components of two-way video calling, lab testing, patient monitoring, and a hospital-matched medication inventory may also have a direct impact on the outcomes of interest. Lab tests help care givers assess the patient's conditions including the presence of an infection, internal bleeding, or need for a blood transfusion. The counter-measures for these clinical issues are well within the capability of the SNF. Other telemedicine components including the monitoring capabilities may identify cardiac or pulmonary conditions that can be addressed via hospital-matched medications such as IV fluids, which can also be administered within the licensure of the SNF.

The clinical decisions based on point of care laboratory results, continuous vital signs data and the availability of supporting treatment capabilities, may be rendered even without a two-way evaluation of the patient from the ED. The SNF team may call the attending provider or medical director and relay the results of the protocol driven testing to receive a change in treatment plan. Conversely, visualization of the patient by the ED physician enables the patient's cognitive and neurologic functions to be factored into the

treatment decision. This cannot be achieved via the traditional method of a telephone call with the Lorien attending. Since the ED is staffed 24 hours per day, this resource is available on-demand for the post-acute facility in this model. The combination of the video calling and expanded diagnostic capabilities and medications may provide benefit as part of a comprehensive program or as individual interventions. As a result, a second analysis will explore how these modules, as independent variables, influence the outcome of interest: ED revisits, 30-day readmissions and acute care transfers or more generically if the patient "remained at the post-acute facility".

The conceptual framework, illustrated in Figure 2 below, illustrates the potential relationship between patient characteristics, care characteristics, the individual telemedicine components, and hospital utilization (patient level analysis). The framework also explores the interplay between patient characteristics, care characteristics and the use of the telemedicine program components.

Figure 2. Conceptual Framework



Study Design

The researcher collected data from a pilot program between University of Maryland Upper Chesapeake Health and Lorien Healthcare. The study population is comprised of Skilled Nursing Facility and Long-term Care residents at the Lorien Bel Air location. These patients were eligible to receive telemedicine services during the pilot program if there was an observed change in their condition. Patients and families were notified during the Lorien admission process of the telemedicine program and had the ability to opt out of the program for any reason. The Lorien Bel Air location was selected for the pilot program due to its proximity to the Upper Chesapeake Medical Center, located just a few miles away.

Clinical inclusion criteria developed in collaboration between the physicians at both UM UCH and Lorien determine if the patient will be directly transferred to the hospital or if the telemedicine process will be initiated. Conditions such as strokes or falls may by-pass telemedicine for a rapid transfer via EMS. Other changes in clinical condition will result in the use of the telemedicine process by protocol. All residents at the CCF location are eligible for the service provided by UM UCH even if their recent hospitalization did not occur there.

The pilot program occurred from December 2014 through November of 2016 after the two organizations mutually developed policies and procedures to govern the telemedicine use. Information was gathered each month tallying the use of the telemedicine process, telemedicine uses that resulted in a video call to the ED, those addressed completely via the Lorien attending and the ED calls that ultimately resulted in

a transfer to the hospital. This analysis will compare the monthly transfer rates during the pilot phase to the 12-month baseline period.

During the pilot program, there were occasions when the patient was a candidate to utilize the telemedicine room, but a transfer occurred prior to any evaluation by a Lorien attending or ED physician. This appeared to happen with frequency during the initial month of implementation and may have been the result of a learning delay by the clinical team at Lorien, where staff did not recognize the patient's telemedicine candidacy, or the provider did not have comfort with the system. After the initial month, the pilot team tracked "missed telemedicine opportunities" and categorized them by the lack of physician availability, a technical challenge or, in some cases, a patient condition issue. Patient choice was not an indicator of missed opportunity, since zero patients opted out of the telemedicine program during the pilot.

The analysis of the pilot program will include descriptive statistics that show the general characteristics of patients at Lorien Bel Air, as well as at a nonintervention location, Lorien Bulle Rock. This location is comparable in size to Lorien Bel Air and will help demonstrate if the population and potential telemedicine results are translatable to other facilities.

Sources of Data

The key outcome measure of the telemedicine program is whether the patient remained at the post-acute facility or not. In addition, 30-day readmissions, acute care hospital transfers and ED visits from the Skilled Nursing patients will be tabulated.

Collectively, these transfers serve as the major dependent variables of the analysis. These metrics can be tracked via the Lorien EMR Transfer Logs and cross referenced with Hospital Admission, Discharge and Transfer (ADT) data provided by UM UCH. Using the Interact guidelines to reduce readmissions, the Lorien team records critical data in the Point-Click-Care EMR system that relates to administrative and clinical issues that may result in a return to the hospital. The outcome metrics, transfers to acute care, can be tracked on a monthly basis and compared to a baseline period. Importantly, Lorien maintains a manual log of each use of the telemedicine exam room even if it does not result in the ED physician being contacted. Patients and family members, as well as providers are also asked to complete a satisfaction survey after each use of the telemedicine program.

Variables and Measures

There are several important variables that have been identified to support exploration of the objectives. In the first analysis, the independent variables reflect the profile of patients within the facility that received care via the comprehensive telemedicine program. For this phase of the analysis, the patient and care characteristics serve as the independent variables, while each of the telemedicine components comprise the dependent variables. This analysis attempts to determine how patient characteristics such as age or clinical condition as well as the time of day or day of week of the medical need influence the use of the telemedicine program, in whole or components.

The second analysis attempts to determine what impact, if any, on hospital utilization (patient remains at post-acute facility) can be achieved through each of the

components of the comprehensive telemedicine program. It is possible that some patient conditions can be addressed entirely within the purview of the Lorien team using lab testing and continuous monitoring but without the two-way video consultation to the Emergency Department. As such, the relative value of each of the telemedicine components in making clinical decisions about the ability to continue treatment at Lorien or the need to transport the patient to UM UCH can be reviewed. These telemedicine components as well as patient and care characteristics serve as independent variables, since they may influence the dependent variables of ED revisits, 30-day readmissions, acute care transfers and remaining at facility. The tables below indicate the key variables associated with the proposed research:

Table 3.

Variable Type: <u>Independent</u> Variables
<u>Objective: #1</u>- Quantify hospital utilization impact of telemedicine under the GBR- How were the telemedicine components influenced by patient and care characteristics (who and when?)

No.	Independent Variable Name	Data Source	Data Type
I-1.	Patient Characteristic: Age	Lorien EMR	Years (Categorical)
Definition: Patient age at the time of the SNF evaluation			
I-2.	Patient Characteristic: Gender	Lorien EMR	Male/Female
Definition: Male or Female			
I-3.	Patient Characteristic: Race	Lorien EMR	Categorical
Definition: Category of race (Asian, African-American Caucasian, Hispanic, Other)			
I-4.	Patient Characteristic: Insurance Coverage	Lorien EMR	Categorical

Definition: Category of patient primary insurance type used to pay for the SNF or LTC admission (Commercial, Hospice Medicare Advantage, Medicare, Medicaid, Private)			
I-5.	Patient Characteristic: Clinical Condition Category1	Lorien EMR	Categorical
Definition: SNF / LTC admission diagnosis - category of clinical condition for which the patient is receiving care in the CCF (Activities of Daily Living, Cardiac, Infection, Neurology Orthopedics, Other, Pulmonary)			
I-6.	Patient Characteristic: Clinical Condition Category2	Lorien EMR	Categorical
Definition: Clinical category for which the patient is in need of the telemedicine service (Cardiac, Infection, Neurology, Other, Pulmonary Unknown)			
I-7.	Care Characteristic: Time of Day	Lorien EMR	Categorical
Definition: Category of the time of day in which the patient evaluation occurred at the SNF (00:00-3:59a, 4:00-7:59a, 8a-11:59a, 12p-3:59p 4p-7:59p, 8p-11:59a,)			
I-8.	Care Characteristic: Day of Week	Lorien EMR	Categorical
Definition: Day of the week during which the evaluation at the SNF occurred (Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday)			

Table 4.

Variable Type: <u>Dependent</u> Variables

<u>Objective: #1</u>- Quantify hospital utilization impact, of telemedicine under the GBR- How were the telemedicine components influenced by patient and care characteristics (who and when?)

No.	Dependent Variable	Data Source	Data Type
D-1.	Two-Way Video Call	Lorien EMR	Count Once if Video Connection
Definition: Hospital ED Provider connects to patient via LifeBot System and completes remote evaluation Numerator: Use of Video Call in telemedicine encounter (No or Yes) Denominator: Total telemedicine encounters			
D-2.	Labs Point of Care Testing	Lorien EMR	Count Once if POC used

			during evaluation
Definition: Use of any POC Lab during patient evaluation with or without use of Two-Way Video Call Numerator: Use of POC in telemedicine encounter (No or Yes) Denominator: Total telemedicine encounters			
D-3.	Medications/ IV Fluids	Lorien EMR	Count Once if Medication Used
Definition: Use of newly available medications and IV fluids prescribed to continue care at Lorien Numerator: Use of Medications or IV Fluids as treatment in telemedicine encounter (No or Yes) Denominator: Total telemedicine encounters			

Table 5.

Variable Type: <u>Independent</u> Variables

<u>Objective: #2</u>- Understand the impacts of the individual components of the comprehensive Telemedicine program – how do patient characteristics, care characteristics, and the individual components of telemedicine impact hospital utilization?

No.	Independent Variable Name	Data Source	Data Type
I-1.	Patient Characteristic: Age	Lorien EMR	Years (Categorical)
Definition: Patient age at the time of the SNF evaluation (Categorical Variable)			
I-2.	Patient Characteristic: Gender	Lorien EMR	Male/Female
Definition: Male or Female			
I-3.	Patient Characteristic: Race	Lorien EMR	Categorical
Definition: Category of race (Asian, African-American, Caucasian, Hispanic, Other)			
I-4.	Patient Characteristic: Insurance Coverage	Lorien EMR	Categorical

Definition: Category of patient primary insurance type used to pay for the SNF or LTC admission (Commercial, Hospice, Medicare Advantage, Medicare, Medicaid, Private)			
I-5.	Patient Characteristic: Admission Diagnosis	Lorien EMR	Categorical
Definition: SNF / LTC admission diagnosis - category of clinical condition for which the patient is receiving care in the CCF (Activities of Daily Living, Cardiac, Infection, Neurology, Orthopedics, Other, Pulmonary)			
I-6.	Patient Characteristic: Clinical Impetus for Telemedicine	Lorien EMR	Categorical
Definition: SNF / LTC diagnosis - category of clinical condition/problem to be addressed via the comprehensive telemedicine program (Cardiac, Infection, Neurology, Other, Pulmonary, Unknown)			
I-7.	Care Characteristic: Time of Day	Lorien EMR	Categorical
Definition: Category of the time of day in which the patient evaluation occurred at the SNF (00:00a-3:59a, 4a-7:59a, 8a-11:59a, 12p-3:59p, 4p-7:59p, 8p-11:59p, Unknown)			
I-8.	Care Characteristic: Day of Week	Lorien EMR	Categorical
Definition: Day of the week during which the evaluation at the SNF occurred (Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday)			
I-9.	Two-Way Video Call	Lorien EMR	Count Once if Video Connection
Definition: Hospital ED Provider connects to patient via LifeBot System and completes remote evaluation Numerator: Use of Video Call in telemedicine encounter (No or Yes) Denominator: Total telemedicine encounters			
I-10.	Labs Point of Care Testing	Lorien EMR	Count Once if POC used during evaluation
Definition: Use of any POC Lab during patient evaluation with or without use of Two-Way Video Call			

Numerator: Use of POC in telemedicine encounter (No or Yes) Denominator: Total telemedicine encounters			
I-11.	Medications/ IV Fluids	Lorien EMR	Count Once if Medication Used
Definition: Use of newly available medications and IV fluids prescribed to continue care at Lorien Numerator: Use of Medications or IV Fluids as treatment in telemedicine encounter (No or Yes) Denominator: Total telemedicine encounters			

Table 6.

Variable Type: <u>Dependent</u> Variables
<u>Objective: #2</u>- Understand the impacts of the individual components of the comprehensive Telemedicine program – how do patient characteristics, care characteristics, and the individual components of telemedicine impact hospital utilization?

No.	Dependent Variable Name	Data Source	Unit of Measure
D-1.	ED Transfers	Lorien Transfer Logs	Count Once if ED Transfer
Definition: Count of patients transferred from Lorien to an acute care hospital Emergency Department and returned to Lorien without a new admission (including observation status)			
D-2.	Acute Care Hospital Transfers	Lorien Transfer Logs	Count Once if Transferred to Hospital
Definition: Count of patients transferred from Lorien to an acute care hospital and admitted, including observation status, *<u>outside</u>* of a 30-day hospital readmission window.			
D-3.	30 Day Readmissions	Lorien Transfer Logs	Count Once if Readmitted to Hospital

Definition: Count of patients transferred from Lorien to an acute care hospital and admitted, including observation status, *within* a 30-day hospital readmission window.			
D-4.	Remained at Facility	Lorien Transfer Logs	Count Once if Resident remained at Lorien
Definition: Count of patients that received a telemedicine service that resulted in the resident remaining at Lorien without a transfer to the hospital.			
Table 7. **Variable Type: Ancillary Outcome Variables** **Objective: #2- Understand the impacts of the individual components of the comprehensive Telemedicine program – how do patient characteristics, care characteristics, and the individual components of telemedicine impact hospital utilization?**			
A-1.	Hospital Cost Avoided	UM UCH Financial Records	Dollars
Definition: Estimated combined hospital variable costs saved through the avoidance of ED visits ($128/ED visit) and patient days ($450/day) as calculated and endorsed by UM UCH Finance Department. Calculations include variable portions of lab tests, imagining studies, nursing hours, etc.			
A-2.	Ambulance Cost Avoided	Lorien EMR/ EMS	Dollars
Definition: Estimated cost billed by EMS or private ambulance company for transportation of Lorien patients to an Acute Care Hospital. Costs will include any leg of transport that are reimbursable.			

Analysis Plan

Several phases of the analysis aid the effort to better understand the impact of telemedicine. A foundation of the analysis includes simple run charts indicating trends in the monthly SNF admissions, which include the baseline and pilot periods. This volume may factor into the amount of future transfer activity at the SNF. Hospital discharge

acuity, as measured by the case mix index, will also be tabulated to indicate the illness burden associated with patients leaving UM UCH for a Lorien bed. This acuity may also influence future transfers from the post-acute site. Capturing the monthly transfer data in the years before and during the intervention allows for a comparison of any changes in the rate in consecutive years at the intervention site, Lorien Bel Air. Additionally, differences in transfer rates for Lorien Bel Air and Lorien Bulle Rock (no intervention) will also be analyzed. The difference in differences analysis requires data sets to be collected for two Lorien locations covering two periods of time. The first period of time is the 12 months prior to the implementation of the telemedicine program at Lorien Bel Air. The second period is the 12 months following implementation of telemedicine. Among possible comparison sites, Lorien Bulle Rock is most similar to Lorien Bel Air in terms of bed size. Any differences in the outcomes between the two locations and within the time interval that precedes and includes the telemedicine intervention help to determine if there is an association between readmission rates and the telemedicine intervention.

Demographic tables that include counts of patients by characteristic category, such as age, gender and clinical condition, are also included. The Lorien EMR data allows for comparison of the characteristics of patients within Lorien and the "care" characteristics of time of day and day of the week that may influence which, if any, components of the telemedicine system were used in the intervention. This stage of the analysis indicates which type of patient or day of the week or time of day is associated with each of the telemedicine components, including 2-way video call, labs, cardiac monitoring and available medications (See table 5 above).

After defining "who" and "when" patients received any or all of the telemedicine services, the impact of the individual program components--two-way video call, lab tests, monitoring and matched medications--on hospital utilization is analyzed. This phase of the analysis examines any relationships among the people (SNF Patients), processes (time), and technology (components) that can reduce the probability of a transfer out of the SNF. A single category of "remained at facility" notes the avoidance of a patient transfer to a higher level of care. This creates an outcome of interest that is binary – was the patient transferred, "yes?" or "no?" A variance inflation factor (VIF) analysis will be conducted to understand if there is any collinearity among the variables. Since most of the data elements can be organized into categorical data, a Pearson's Chi Squared and a Hosmer-Lemeshow fit test will ensure that the regression model is appropriate for estimating the odds of transfer.

Finally, hospital variable cost estimates associated with avoided ED visits and hospital patient days will be calculated based on the UM UCH finance department's methodology. An average charge estimate for ambulance transfers will also be calculated as part of the analysis.

CHAPTER 4
RESULTS

Study Population – All Lorien Residents

The study examined data from the telemedicine pilot location, Lorien Bel Air, and a non-telemedicine comparison site, Lorien Bulle Rock, to understand the resident populations and identify any differences that may make it difficult to replicate the comprehensive telemedicine program. Lorien Bulle Rock is located in Havre de Grace, Maryland, approximately 15 miles to the North East of Lorien Bel Air. The primary sources of patients for both Lorien facilities are the two UM UCH hospitals. The total time frame for this study was 24 consecutive months beginning in December 2014 and concluding at the end of November 2016. Program Year 1 is noted as December 2014 – November 2015, and Program Year 2 is December 2015 – November 2016.

This initial analysis focused on the demographic characteristics of patients at each location including age (by category in 5-year increments), gender, race, and insurance type as gathered from the Lorien electronic medical record system, called Point-Click-Care. One record was captured for each month a patient resided in either location, such that a patient that was admitted to the Bel Air SNF on January 28th and discharged on February 15th, would have a discrete record for January and a second record for February.

In total there were 2,579 observations combined at SNF and LTC at Lorien Bel Air and 2,399 at Bulle Rock during the study period. There were 990 unique patients at Bel Air and 733 unique patients at Bulle Rock during the 24-month comparison time.

Table 8. displays the unique patient demographic characteristics tabulated using the Stata15 statistical software.

Table 8.

Unique Lorien Patients	Bel Air	Bulle Rock	Total
Demographics	n=990	n=733	n=1723
Age - Years			
Mean	80.58	78.41	79.67
SD	9.57	10.94	10.23
Gender (%)			
Male	291 (29.4%)	263 (35.9%)	554 (32.2%)
Female	699 (70.6%)	470 (64.1%)	1,169 (67.8%)
Race (%)			
Asian	6 (0.6%)	10 (1.4%)	16 (0.9%)
African American	34 (3.4%)	117 (16.0%)	151 (8.8%)
Caucasian	943 (95.3%)	603 (82.3%)	1,546 (89.7%)
Hispanic	4 (0.4%)	2 (0.3%)	6 (0.3%)
Other	3 (0.3%)	1 (0.1%)	4 (0.2%)
Insurance (%)			
Commercial	74 (7.5%)	69 (9.4%)	143 (8.3%)
Hospice	1 (0.1%)	0 (0.0%)	1 (0.1%)
Medicare Advantage	21 (2.1%)	15 (2.0%)	36 (2.1%)
Medicare	842 (85.1%)	571 (77.9%)	1,413 (82.0%)
Medicaid	39 (3.9%)	45 (6.1%)	84 (4.9%)
Private	13 (1.3%)	22 (3.0%)	35 (2.0%)
Insurance Change (%)			
Yes- Multiple Payers	13 (1.3%)	22 (3.0%)	35 (2.0%)
No- Single Payer	977 (98.7%)	711 (97.0%)	1,688 (98.0%)
Bed Type (%)			
SNF	861 (87.0%)	585 (79.8%)	1,446 (83.9%)
LTC	129 (13.0%)	148 (20.2%)	277 (16.1%)
Admit Diagnosis Category (%)			
Activities of Daily Living	75 (7.6%)	92 (12.6%)	167 (9.7%)
Cardiology	116 (11.7%)	96 (13.1%)	212 (12.3%)
Infections	69 (7.0%)	57 (7.8%)	126 (7.3%)
Neurology	95 (9.6%)	100 (13.6%)	195 (11.3%)
Orthopedics	299 (30.2%)	182 (24.8%)	481 (27.9%)
Other	260 (26.3%)	135 (18.4%)	395 (22.9%)
Pulmonology	76 (7.7%)	71 (9.7%)	147 (8.5%)

The mean age upon admission for unique patients at Bel Air was 80.6 and 78.4 at Bulle Rock. In addition, the vast majority of unique patients at both locations were white, 95.3% at Bel Air and 82.3% at Bulle Rock with 16% of patients who were African American/Black population at Lorien Bulle Rock compared to 3.4% at Bel Air. No other race garnered more than 2% of the total population at either location.

Lorien residents that started the month with one insurance and converted to another mid-month were also compared. This comparison highlights the misaligned payer incentives by illustrating how multiple insurers can be responsible for medical treatment reimbursement if the patient leaves long-term care, returns to the hospital and then returns to the Lorien facility with a skilled nursing need. In such cases, it is typical that Medicaid pays during the LTC stay and Medicare pays for the SNF days. For the study period, 13 unique patients from Lorien Bel Air converted their insurance status while 22 patients changed coverage at Bulle Rock

From a clinical perspective, there were differences in the admission diagnosis for the two populations. Nearly two-thirds of Lorien Bel Air admissions were for orthopedic (30.2%), "other" diagnosis (26.3%) or cardiac diagnosis (11.7%). The "other" category may have included gastrointestinal conditions, oncology treatments, or otolaryngology. At Bulle Rock, the leading clinical conditions for admission were orthopedic (24.8%), "other" diagnosis (18.4%) or Neurologic diagnosis (13.6%).

Study Population – Volume and Acuity

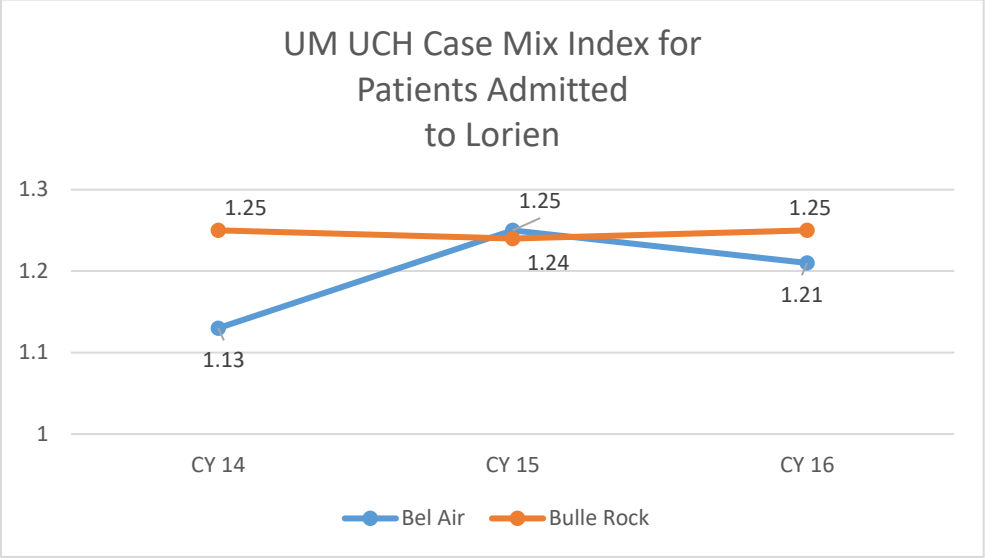
To understand the illness burden of patients that were transferred from UM UCH to either of the Lorien facilities, data were collected from the UM UCH electronic medical record system, Meditech. The UM UCH data system assigned the "All Patients Refined Diagnosis Related Groups" (APR DRG) case weights for each acute care discharge to Lorien and created the average for calendar year 2014 through calendar year 2016. Although the pilot program started at Lorien in December of 2014, the case mix data were run for the calendar year to represent the patient acuity for the period before telemedicine, while calendar year 2015 and 2016 coincide with the program as shown in Figure 3.

Figure 3.

Calendar 2014	Calendar 2015	Calendar 2016
Case Mix Baseline Year	**Case Mix Program Year 1**	**Case Mix Program Year 2**
	Dec 14 -**Telemedicine Year 1** - Nov 15	Dec 15 -**Telemedicine Year 2** - Nov 16

Figure 4. shows the annual average case mix index for patients that were admitted to each Lorien facility after a discharge from UM UCH. The Bulle Rock location was consistent with a 1.25, 1.24 and 1.25 case mix index in each of the three years of the study. Lorien Bel Air, however, showed a 9.7% increase in its case mix index from a low of 1.13 in the year prior to the start of the Telemedicine program up to 1.24 during the first full year of the pilot.

Figure 4.

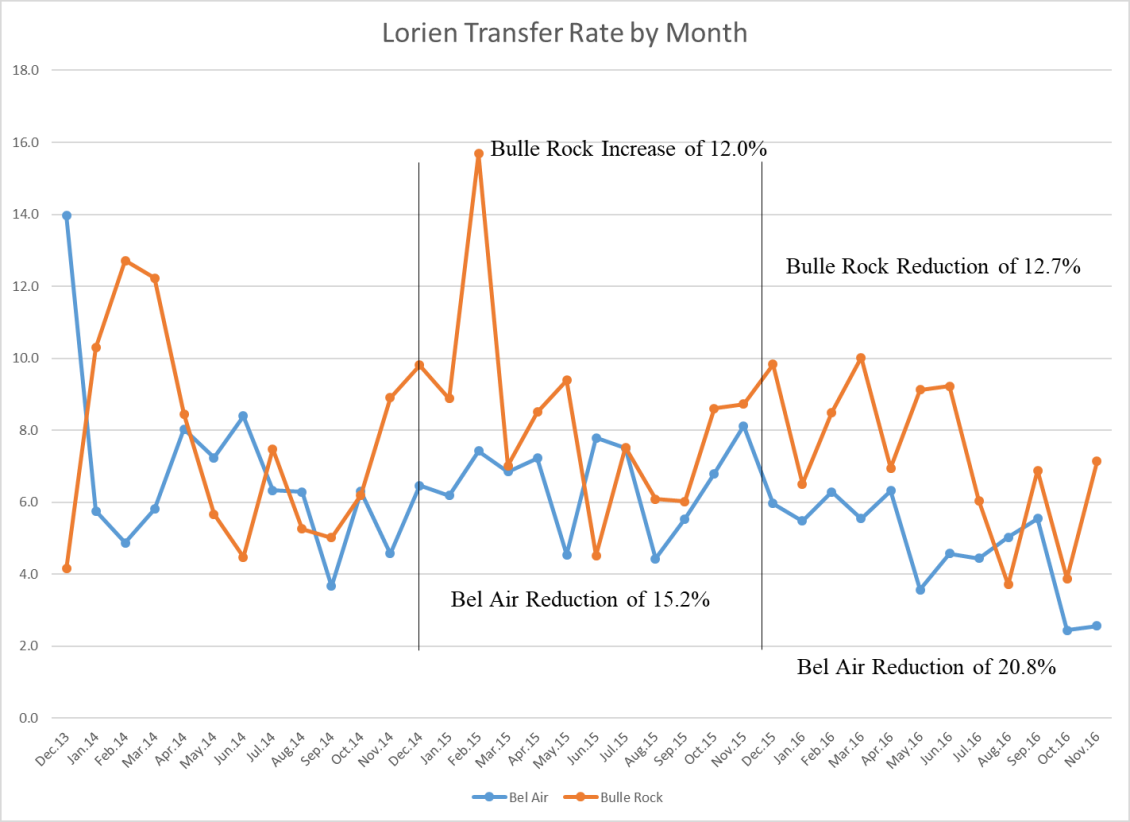


Two major factors, volume and illness burden of patients, can potentially impact the transfer activity at a continuing care facility. The patient transfers from Lorien were culled from the transfer logs captured in the Lorien EMR which tagged the patient as either a SNF admissions or LTC resident during each month of the study period. While the Bulle Rock location showed an annual increase of 13.6% in total transfers during program year 1 compared to the baseline 12-month period, the Bel Air location showed reductions in total transfers in both program year 1 and program year 2, 4.9% and 32.3% respectively.

A post-acute transfer rate per 1,000 patient days was calculated for each of the Lorien locations by dividing the transfers in each month by the number of combined SNF and LTC resident days. Adjusting for the volume of resident days in each location, Lorien Bel Air showed a 15.2% reduction in its transfer rate in program year 1 and a further reduction of 20.8% in program year 2. Bulle Rock meanwhile, experienced an

increase in its transfer rate of 12.0% from baseline to program year 1, followed by a reduction in program year 2 of 12.7%. Figure 5 displays a run chart of the transfer rates for both Lorien locations for the 12 months prior to the telemedicine implementation through the 24 months of the program.

Figure 5.



It appears, then, that the skilled nursing patients at Lorien Bel Air were slightly more acute during the pilot program years, a time when the rate of transfers to acute care hospitals decreased.

Study Population – Use of comprehensive telemedicine

The Telemedicine system was deployed in December of 2014 as a two-year pilot program. In this 24-month period, there were 236 uses of all or portions of the telemedicine program by 180 unique patients. Table 9. shows the frequency of use by unique patients. Each of the 236 observations were included in the telemedicine analysis because the use of the comprehensive program may have led to a different outcome or reliance on a different component of the system each time. The observed change in patient status, noted as the telemedicine diagnosis, may have also changed for patients that received services on multiple occasions.

Table 9.

	All Telemedicine n=180
Patients with 1 Encounter	146
Patients with 2 Encounters	23
Patients with 3 Encounters	5
Patients with 4 Encounters	2
Patients with 5 Encounters	3
Patients with 6 Encounters	1

Demographic characteristics of patients that used the telemedicine system as well as the facility characteristics, noted as day of week and time of day, are displayed in Tables 10 and 11. The mean age of this population was 82.5 years and approximately 60% of the patients were female. Notably, two-thirds (67.4%) of the patients were in a skilled nursing status when in need of the telemedicine service and Medicare (66.5%) was the insurer for the majority of the patients. Clinically, patients admitted with orthopedic and "other" diagnoses, such as GI conditions, accounted for the largest percentage of use. The diagnosis or clinical reason for the use of the telemedicine system

was primarily categorized as “other” and included change in mental status, issues with skin, and changes in urine output/quality, among other reasons.

At the facility level, the volume of telemedicine instances was well spread over all seven days of the week. The minimum frequency of uses, 26, occurred on Saturday and the maximum, 40, occurred on Monday. No day of the week captured less than 11% of the volume or more than 16.9%. The most frequently observed uses of the system took place during the 12 p.m.to 3:59 p.m. time block (31.8%) or between 8 a.m. and 11:59 a.m. (24.6%). It should be noted that these are time blocks that are more likely to have a Lorien prescriber on-site at the facility or easily available via telephone. This may negate the need for a two-way video call to resolve the issue.

Table 10.

	All Telemedicine
Demographics	n=236
Age - Years	
Mean	82.5
SD	9.13
Gender (%)	
Male	93 (39.4%)
Female	143 (60.6%)
Race (%)	
Asian	1 (0.4%)
African American	5 (2.1%)
Caucasian	226 (95.8%)
Hispanic	3 (1.3%)
Other	1 (0.4%)
Insurance (%)	
Commercial	12 (5.1%)
Hospice	0 (0.0%)
Medicare Advantage	2 (0.8%)
Medicare	157 (66.5%)
Medicaid	60 (25.4%)
Private	5 (2.1%)
Insurance Change (%)	
Yes- Multiple Payers	6 (2.5%)
No- Single Payer	230 (97.5%)
Bed Type (%)	
SNF	159 (67.4%)
LTC	77 (32.6%)
Admit Diagnosis Category (%)	
Activities of Daily Living	18 (7.6%)
Cardiology	31 (13.1%)
Infections	19 (8.1%)
Neurology	34 (14.4%)
Orthopedics	60 (25.4%)
Other	61 (25.8%)
Pulmonology	13 (5.5%)

Table 11.

	All Telemedicine
Demographics	n=236
TeleMed Diagnosis Category (%)	
Cardiology	7 (3.0%)
Infections	33 (14.0%)
Neurology	31 (13.1%)
Other	138 (58.5%)
Pulmonology	20 (8.5%)
Unknown	7 (3.0%)
Day of Week (%)	
Sunday	33 (14.0%)
Monday	40 (16.9%)
Tuesday	30 (12.7%)
Wednesday	37 (15.7%)
Thursday	36 (15.3%)
Friday	34 (14.4%)
Saturday	26 (11.0%)
Day of Week (%)	
00:00-3:59 AM	20 (8.5%)
4:00-7:59 AM	28 (11.9%)
8:00-11:59 AM	58 (24.6%)
12:00-3:59 PM	75 (31.8%)
4:00-7:59 PM	34 (14.4%)
8:00-11:59 PM	14 (5.9%)
Unknown	7 (3.0%)

The frequency of use of the components of the comprehensive telemedicine program have been displayed in Table 12. The proportion of observations that included a point of care lab test, such as a Urine Analysis, Basic Metabolic Panel, etc., was 89%. Use of the system that included monitoring was also high with 78.4%. The use of the program that included a medication that was matched to those available in the UM UCH Emergency Department was only 14.4% and the two-way video call proportion was less than 12 percent, the lowest of the four telemedicine program components.

Table 12.

	All Telemedicine
Demographics	n=236
Two-Way Video (%)	
Yes - Connect to ED	27 (11.4%)
No Connection	209 (88.2%)
Monitoring (%)	
Yes	185 (78.4%)
No	51 (21.6%)
Labs (%)	
Yes	210 (89.0%)
No	26 (11.0%)
Medications (%)	
Yes	34 (14.4%)
No	202 (85.6%)

The Lorien team tracked instances where the attempts to complete a connection to UM UCH were unsuccessful. During the 24-month period, there were nine such cases resulting from a technical issue (4 times), provider issue (4) or patient condition deterioration (1) prior to the connection, which resulted in a treatment change without the use of the telemedicine system. There were other occasions during the pilot program when an element of the comprehensive program, such as labs or EKG was completed by protocol prior to connection with the ED. Based on this information shared as part of the video call notification process, the hospital provider overruled the use of the video call and requested the patient transfer prior to conducting a consultation. These data were not explicitly captured on the telemedicine log and are not included in this analysis.

Regression Models - Univariate

Using the Stata statistical analysis software version 15.1, logistic regression models were completed according to the conceptual framework. This required the use of patient (demographics) and care (time of day/ day of week) characteristics to serve as both independent and dependent variables at different stages of the analysis. The patient characteristics included the basic information such as age, gender, race, insurance type and notation of changes in the patient's insurance payer during the month of observation. In addition, the patient's bed status regarding skilled nursing or long-term care, was recorded. Clinically, both the diagnosis associated with the facility admission as well as the medical issue in need of evaluation via the telemedicine program were captured.

After creating the categorical variables, three cross-tabulations, Tables 13.1, 13.2 and 13.3, were created to display the occurrences that the patient and care characteristics were observed to have with each of the telemedicine components. This is an important first step, as it can illustrate a lack of variation in the independent variable for certain dependent variables. For example, 84% of the telemedicine observations were for patients of the Caucasian race. This results in a new video call for each 8.7 uses of the telemedicine program for Caucasian residents. Since the count of telemedicine use for each of the other races did not exceed five and given the relatively small proportion of patients that received a video call, a regression model with the dependent variable of video call and the independent variable of race, would yield a result that is likely to include zero occurrences for most of the race categories. This lack of heterogeneity limits the information that can be obtained from this variable. As a result, the logistic

regression model output tables display ordered categorical data for which there is enough variation.

Table 13.1.

Count of Occurrence	Video Call		Lab		Monitoring		Medications	
Total Observations (N=236)	No	Yes	No	Yes	No	Yes	No	Yes
Demographics								
Bed Type								
SNF	140	19	20	139	36	123	142	17
LTC	69	8	6	71	15	62	60	17
Total	209	27	26	210	51	185	202	34
Age Category								
40-44	1	0	0	1	0	1	1	0
45-49	0	0	0	0	0	0	0	0
50-54	1	0	0	1	0	1	1	0
55-59	1	0	0	1	0	1	0	1
60-64	5	2	3	4	1	6	6	1
65-69	8	1	2	7	2	7	8	1
70-74	17	5	4	18	5	17	18	4
75-79	35	5	3	37	14	26	37	3
80-84	42	3	6	39	10	35	39	6
85-89	46	3	4	45	3	46	42	7
90-94	39	4	3	40	13	30	35	8
95+	14	4	1	17	3	15	15	3
Total	209	27	26	210	51	185	202	34
Gender								
Male	83	10	8	85	23	70	84	9
Female	126	17	18	125	28	115	118	25
Total	209	27	26	210	51	185	202	34
Race								
Asian	1	0	0	1	0	1	1	0
African American	5	0	0	5	0	5	5	0
Caucasian	199	27	26	200	51	175	192	34
Hispanic	3	0	0	3	0	3	3	0
Other	1	0	0	1	0	1	1	0
Total	209	27	26	210	51	185	202	34

Table 13.2.

Count of Occurrence	Video Call		Lab		Monitoring		Medications	
Total Observations (N=236)	No	Yes	No	Yes	No	Yes	No	Yes
Demographics								
Insurance								
Commerical	10	2	2	10	3	9	9	3
Medicare-Hospice	0	0	0	0	0	0	0	0
Medicare Advantage	2	0	1	1	0	2	2	0
Medicare	138	19	19	138	36	121	140	17
Medicaid	55	5	4	56	11	49	47	13
Private	4	1	0	5	1	4	4	1
Total	209	27	26	210	51	185	202	34
Admission Dx								
Act. Daily Living	18	0	0	18	5	12	15	3
Cardiology	23	8	8	23	4	27	25	6
Infections	19	0	2	17	10	9	18	1
Neurology	31	3	1	33	8	26	28	6
Orthopedics	53	7	5	55	13	47	50	10
Other	54	7	9	52	9	53	53	8
Pulmonary	11	2	1	12	2	11	13	0
Total	209	27	26	210	51	185	202	34
Insurance Change								
No Change	204	26	24	206	51	179	199	31
Change	5	1	2	4	0	6	3	3
Total	209	27	26	210	51	185	202	34
Telemedicine Dx								
Cardiology	2	5	4	3	0	7	5	2
Infections	31	2	2	31	14	19	29	4
Neurology	25	6	3	28	4	27	23	8
Other	131	7	9	129	26	112	125	13
Pulmonary	13	7	7	13	1	19	13	7
Unknown	7	0	1	6	6	1	7	0
Total	209	27	26	210	51	185	202	34

Table 13.3.

Count of Occurrence	Video Call		Lab		Monitoring		Medications	
Total Observations (N=236)	No	Yes	No	Yes	No	Yes	No	Yes
Demographics								
Day of Week								
Sunday	31	2	3	30	6	27	26	7
Monday	36	4	3	37	9	31	33	7
Tuesday	29	1	0	30	8	22	27	3
Wednesday	31	6	7	30	11	26	33	4
Thursday	29	7	5	31	5	31	29	7
Friday	31	3	5	29	7	27	31	3
Saturday	22	4	3	23	4	21	23	3
Total	209	27	26	210	51	185	202	34
Time of Day								
00:00-3:59a	17	3	3	17	6	14	18	2
4:00-7:59a	25	3	2	26	6	22	27	1
8:00-11:59a	48	10	7	51	9	49	46	12
12:00-3:59p	67	8	10	65	10	65	64	11
4:00-7:59p	32	2	3	31	12	22	28	6
8:00-11:59p	13	1	1	13	5	9	12	2
Unknown	7	0	0	7	3	4	7	0
Total	209	27	26	210	51	185	202	34

Next, unadjusted regressions were completed with the each of the four telemedicine program components serving as the dependent variable with the individual patient and care characteristics used as the explanatory variables. These components included the two-way video call to UM UCH, point of care laboratory testing, continuous vital sign monitoring including blood pressure, pulse oximetry and EKG, as well as the UM UCH matched medications and fluids. Tables 14.1, 14.2 and 14.3 display the unadjusted odds ratios and P-values for the patient and care characteristics that are associated with the odds of receiving each of the four telemedicine components. Variables with a lack of occurrences and therefore variation, are indicated with a "*" in tables 14.1, 14.2 and 14.3.

For each of the independent patient and care variables a reference category was identified to help understand any changes in outcomes based on changes within these characteristics. The age category, 80-84, that included the mean age of telemedicine patients, 82, was established as the reference group for the age category. For the insurance variable, Medicare was selected as the reference category given it had the greatest frequency of occurrence for the telemedicine population, 157 of 236 interventions. Likewise, orthopedics was selected as the reference category for admission diagnosis (60 observations) while infections comprise the reference category for the telemedicine diagnosis variable (33 observations) because it was the most frequently occurring diagnosis not categorized as "other."

Reference categories were also identified for the care characteristics of day of week and time of day. Wednesday was selected as the reference group for the day of week variable even though it was not the day with the most telemedicine observations. In fact, there were 40 uses of the telemedicine system on Mondays during the pilot. However, two key factors may have impacted the use of the system, as the team on Monday was more likely to be very experienced and perhaps more open to the use of the telemedicine system, and there may also have been some pent-up demand lingering from the weekend that was captured in the Monday observations. This may have overstated the utilization for Monday and resulted in the rationale for the selection of Wednesday as the reference category with 38 observations. The reference group for the time variable was the period of the day when the most use of the system occurred during the pilot, 12:00-3:59p.m. with 75 observations. Here, many independent variables appear to be associated with changes in the odds of receiving a telemedicine element. First, patients in

long-term care beds were 2.37 times more likely to have a medication prescribed as part of the telemedicine use than patients in a skilled nursing bed status (p=0.02). Similarly, the odds of receiving continuous monitoring as part of the intervention increased by 4.3 times for patients aged 85-89 compared to those aged 80-84. (p=0.03). Patients with Medicaid insurance were 2.28 times more likely to have received a medication as part of the evaluation than their peers with Medicare coverage (p=0.04). Furthermore, patients that converted insurance coverage within the month of telemedicine service were 6.42 times more likely to have a medication administered as part of the intervention than those that maintained single payer coverage (p=0.03). This may be related to the Medicaid/Medications association noted above, as most of the patients that convert insurance type are moving from a SNF status with Medicare coverage to a LTC status with Medicaid serving as the payer.

The univariate regressions also indicate some associations based on the initial Lorien admission condition category as well as the diagnosis category for which the telemedicine intervention was being accessed. The odds of having a lab test in the intervention were 74% lower for cardiac patients compared to those admitted with orthopedic conditions (p=0.03). Patients admitted with infections were 75% less likely to receive patient monitoring as part of their intervention compared to the reference group (p=0.01). Several clinical conditions appeared to have associations with different telemedicine system components. Most significantly, cardiac patients matriculating to the telemedicine suite were nearly 39 times more likely to have a video call compared to those with infections (p=<0.0). These same patients had a 95% reduction in the odds of receiving a lab test compared to the infection patient population (p=<0.0). Patients with

pulmonary conditions showed significant associations for video calls and lab testing. This population of patients was 8.3 times more likely to receive a video call compared to the reference group (p=0.01) and also showed an 88% reduction in odds of having a point of care test compared to the infections population (p=0.01). The odds of receiving patient monitoring as part of the intervention increased 4.97 (p=0.01) times for neurology patients and 3.17 (p=0.01) times for "other" patients compared to the reference group.

There were also associations between certain care characteristics and the telemedicine components. Patients receiving telemedicine services on Saturday were 1.7 times more likely to have a lab test as part of their evaluation compared to patients on Wednesdays (p=<0.0). Also, the odds of receiving patient monitoring decreased by 72% for patients accessing telemedicine between both 4 p.m.-7:59 p.m. (P=0.01) and 8:00 p.m.- 11:59 p.m.(p=0.05) compared to those in the telemedicine program between 12:00 p.m. and 3:59 p.m.

Table 14.1.

Odds Ratios	Video Call	Lab	Monitoring	Medications
Total Patients (N=236)	Yes=27	Yes=210	Yes=185	Yes=34
Demographics				
Bed Type				
SNF				
LTC	0.85 (P=0.72)	1.70 (P=0.28)	1.21 (P=0.58)	**2.37 (P=0.02)**
Age Category				
80-84				
40-44	*	*	*	*
45-49	*	*	*	*
50-54	*	*	*	*
55-59	*	*	*	*
60-64	5.60 (P=0.09)	0.21 (P=0.07)	1.71 (P=0.64)	1.08 (P=0.95)
65-69	1.75 (P=0.65)	0.54 (P=0.50)	1.00 (P=1.0)	0.81 (P=0.85)
70-74	4.12 (P=0.07)	0.69 (P=0.62)	0.97 (P=0.96)	1.44 (P=0.60)
75-79	2.00 (P=0.37)	1.89 (P=0.39)	0.53 (P=0.19)	0.53 (P=0.40)
85-89	0.91 (P=0.91)	1.73(P=0.42)	**4.3 (P=0.03)**	1.08 (P=0.90)
90-94	1.43 (P=0.65)	2.05 (P=0.33)	0.65 (P=0.39)	1.49 (P=0.50)
95+	4.00 (P=0.09)	2.61 (P=0.39)	1.42 (P=0.62)	1.30 (P=0.73)
Gender				
Male				
Female	1.12 (P=0.79)	0.65 (P=0.34)	1.35 (P=0.35)	2.00 (P=0.10)
Race				
Caucasian				
Asian	*	*	*	*
African American	*	*	*	*
Hispanic	*	*	*	*
Other	*	*	*	*

Table 14.2.

Odds Ratios	Video Call	Lab	Monitoring	Medications
Total Patients (N=236)	Yes=27	Yes=210	Yes=185	Yes=34
Demographics				
Insurance				
Medicare				
Commerical	1.45 (P=0.64)	0.69 (P=0.65)	0.89 (P=0.88)	2.75 (P=0.16)
Medicare-Hospice	*	*	*	*
Medicare Advantage	*	0.14 (P=0.17)	*	*
Medicaid	0.66 (P=0.43)	1.92 (P=0.25)	1.33 (P=0.46)	**2.28 (P=0.04)**
Private	1.81 (P=0.60)	*	1.20 (P=0.88)	2.06 (P=.53)
Admission Dx				
Orthopedics				
Act. Daily Living	*	*	0.72 (P=0.60)	1.00 (P=1.0)
Cardiology	2.63 (P=0.09)	**0.26 (P=0.03)**	1.90 (P=0.31)	1.20 (P=0.75)
Infections	*	0.77 (P=0.77)	**0.25 (P=0.01)**	0.28 (P=0.24)
Neurology	0.73 (P=0.67)	3.00 (P=0.32)	0.90 (P=0.84)	1.07 (P=0.90)
Other	0.98 (P=0.97)	0.53 (P=0.28)	1.60 (P=0.33)	0.75 (P=0.58)
Pulmonary	1.37 (P=0.71)	1.09 (P=0.94)	1.52 (P=0.61)	*
Insurance Change				
No Change				
Change	1.56 (P=0.69)	0.23 (P=0.10)	*	**6.42 (P=0.03)**
Telemedicine Dx				
Infections				
Cardiology	**38.7 (P=<0.0)**	**0.05 (P=<0.0)**	*	2.90 (P=0.28)
Neurology	3.72 (P=0.12)	0.60 (P=0.59)	**4.97 (P=0.01)**	2.52 (P=0.17)
Other	0.83 (P=0.82)	0.92 (P=0.92)	**3.17 (P=0.01)**	0.75 (P=0.64)
Pulmonary	**8.35 (P=0.01)**	**0.12 (P=0.01)**	14.0 (P=0.15)	3.90 (P=0.06)
Unknown	*	0.39 (P=0.47)	0.12 (P=0.07)	*

Table 14.3.

Odds Ratios	Video Call	Lab	Monitoring	Medications
Total Patients (N=236)	Yes=27	Yes=210	Yes=185	Yes=34
Demographics				
Telemedicine Dx				
Infections				
Cardiology	**38.7 (P=<0.0)**	**0.05 (P=<0.0)**	*	2.90 (P=0.28)
Neurology	3.72 (P=0.12)	0.60 (P=0.59)	**4.97 (P=0.01)**	2.52 (P=0.17)
Other	0.83 (P=0.82)	0.92 (P=0.92)	**3.17 (P=0.01)**	0.75 (P=0.64)
Pulmonary	**8.35 (P=0.01)**	**0.12 (P=0.01)**	14.0 (P=0.15)	3.90 (P=0.06)
Unknown	*	0.39 (P=0.47)	0.12 (P=0.07)	*
Day of Week				
Wednesday				
Sunday	0.33 (P=0.2)	2.33 (P=0.26)	1.90 (P=0.27)	2.22 (P=0.24)
Monday	0.57 (P=0.42)	2.88 (P=0.15)	1.46 (P=0.47)	1.75 (P=0.41)
Tuesday	0.18 (P=0.12)	*	1.16 (P=0.78)	0.92 (P=0.91)
Thursday	1.25 (P=0.72)	1.45 (P=0.56)	2.62 (P=0.11)	1.99 (P=0.31)
Friday	0.50 (P=0.36)	1.35 (P=0.64)	1.63 (P=0.37)	0.80 (P=0.78)
Saturday	0.94 (P=0.93)	**1.79 (P=<0.0)**	1.78 (P=0.35)	1.08 (P=0.93)
Time of Day				
12:00-3:59p				
00:00-3:59a	1.48 (P=0.59)	0.87 (P=0.85)	0.36 (P=0.08)	0.65 (P=0.59)
4:00-7:59a	1.01 (P=0.99)	2.00 (P=0.40)	0.56 (P=0.32)	0.22 (P=0.15)
8:00-11:59a	1.74 (P=0.28)	1.12 (P=0.83)	0.84 (P=0.72)	1.52 (P=0.36)
4:00-7:59p	0.52 (P=0.43)	1.59 (P=0.50)	**0.28 (P=0.01)**	1.25 (P=0.69)
8:00-11:59p	0.64 (P=0.70)	2.00 (P=0.53)	**0.28 (P=0.05)**	0.97 (P=0.97)
Unknown	*	*	0.21 (P=0.6)	*

In the second unadjusted analysis, the previous dependent variables of receiving a video call, lab tests, continuous monitoring and medications became the independent variables. This univariate analysis included the dependent variables of ED visit, readmission, acute transfer, and remained at the facility. These utilization statistics describe transfers to the hospital for evaluation that occurred in the ED with immediate return to the SNF, admissions that occurred within 30 days of the previous hospital discharge, or transfers to the hospital that result in an admission outside of the 30-day readmission window. The final category of "remained at facility" indicates the ability of the clinicians to alter treatments without a transfer to a higher level of care.

Here, the program components showed significant associations with the outcomes of interest. Odds ratios and p-values were calculated and displayed in Table 14. Most notably, the odds of having an ED visit (n=8) increased 29 times for patients that had a video call compared to patients that did not receive a remote visual evaluation as part of the telemedicine episode (p=<0.0). Likewise, the odds of readmission (n=27) for patients that received a video call are 6.64 times greater than the odds for patients that did not receive a video call (p=<0.0). A further association of lab testing, and readmissions was noted, with the odds of readmission decreasing by 91% for patients that received a lab test compared to those that did not receive a lab test during the encounter (p=<0.0).

For all hospital utilization combined into the "remained at facility" variable, the odds of remaining at the Lorien facility (n=197) decreased by 94% for patients that did receive a video call as part of the telemedicine evaluation compared to those that did not receive a video evaluation (p=<0.0). Additionally, patients that remained at the facility were 13 times more likely to have a point of care test than those patients who did not have a point of care lab test (p=<0.0). If the goal of a telemedicine program is to treat patients in place at the CCF, then it appears that point of care lab testing capability is a key factor in reducing transfers.

There were other variables that did not show statistically significant associations but are interesting, nonetheless. These include odds that are 2.36 times higher of readmission for patients that received a medication compared to those that did not (p=0.07). The odds of acute care transfer outside of the 30-day readmission window increased by 5.5 times for patients that did received a video call (p=0.07) and decreased

83% for those that had a lab test compared to those that did not have a lab test (p=0.06). Table 15. below highlight these areas of unadjusted associations.

Table 15.

Odds Ratios	ED Visit	Readmission	Acute Trans.	Remained at Facility
Components	Yes (n=8)	Yes (n=27)	Yes (n=5)	Yes (n=197)
Video Call (n=27)				
No Call				
Yes Call	**29.57 (P=0.00)**	**6.64 (P=0.00)**	5.50 (P=0.07)	**0.06 (P=0.00)**
Lab (n=210)				
No Lab				
Yes Lab	0.35 (P=0.20)	**0.09 (P=0.00)**	0.17 (P=0.06)	**13.0 (P=0.00)**
Monitoring (n=185)				
No Monitoring				
Yes Monitoring	*	2.39 (P=0.12)	0.40 (P=0.34)	0.48 (P=0.12)
Medications (n=34)				
No Medications				
Yes Medications	*	2.36 (P=0.07)	1.50 (P=0.72)	0.59 (P=0.23)

Regression Model – Multivariate

Multivariate regression models were created to simultaneously examine relationships among the various independent variables and the outcomes of interest. These included bed type, age category (in 5-year increments), insurance type, insurance change, admission diagnosis, telemedicine diagnosis, day of week, and time of day. Table 16.1. displays the odds ratios, 95% confidence intervals and p-values for each of these variables when holding all other independent variables constant. This multi-variate analysis showed significant associations with two patient characteristics and one care characteristic. It appears that patients that are older than the reference group of 80-84 are at increasing odds of remaining at the facility. Telemedicine diagnosis also appeared to

have an association with the variable of remaining at the facility. Here, those with cardiac or pulmonary conditions were less likely to remain at the facility than those with infections. Finally, those patients receiving the telemedicine services between 4:00 a.m. and 7:59 a.m. were more than 36 times more likely to remain at the facility compared to patients that accessed the system between 12:00 p.m. and 3:59 p.m. ($p=<0.0$).

Table 16.1.

Odds Ratios	Remained at Facility	95% CI	P-Value
Total Patients (N=236)			
Demographics			
Bed Type			
SNF			
LTC	1.30	0.08-20.03	P=0.85
Age Category			
80-84			
60-64	1.01	0.14-7.51	P=0.99
65-69	1.88	0.20-17.57	P=0.58
70-74	0.79	0.19-3.34	P=0.75
75-79	5.51	0.79-38.67	P=0.09
85-89	**6.84**	**1.02-46.07**	**P=0.05**
90-94	**10.49**	**1.60-68.48**	**P=0.01**
95+	**73.71**	**8.40-647.27**	**P=<0.0**
Insurance			
Commerical	1.23	0.06-24.25	P=0.89
Medicaid	4.22	0.33-53.41	P=0.26
Admission Dx			
Cardiology	1.09	0.09-13.25	P=0.94
Infections	3.74	0.14-103.46	P=0.44
Neurology	3.05	0.38-24.33	P=0.29
Orthopedics	2.05	0.30-14.08	P=0.47
Other	0.46	0.07-3.16	P=0.44
Pulmonary	0.08	0.00-1.56	P=0.10
Insurance Change			
No Change			
Change	0.77	0.07-8.33	P=0.83
Telemedicine Dx			
Cardiology	**0.001**	**0.00-0.03**	**P=<0.0**
Neurology	0.18	0.02-1.39	P=0.10
Other	1.01	0.16-6.39	P=<0.99
Pulmonary	**0.18**	**0.00-0.16**	**P=<0.0**
Day of Week			
Wednesday			
Sunday	1.31	0.13-12.76	P=0.82
Monday	0.69	0.08-5.78	P=0.74
Tuesday	4.11	0.43-38.90	P=0.22
Thursday	0.74	0.10-5.20	P=0.76
Friday	1.27	0.19-8.44	P=0.81
Saturday	1.01	0.12-8.64	P=0.99
Time of Day			
12:00-3:59p			
00:00-3:59a	1.12	0.16-7.98	P=0.91
4:00-7:59a	**36.56**	**3.16-423.61**	**P=<0.0**
8:00-11:59a	0.78	0.22-2.76	P=0.70
4:00-7:59p	0.95	0.18-4.98	P=0.95
8:00-11:59p	2.12	0.23-19.63	P=0.51

The variables that did not show significant associations were removed from a second multi-variate analysis. The cardiac (p=<0.0) and pulmonary (p=<0.0) telemedicine diagnoses continued to be associated with lower odds of remaining at the facility. The time of day category, 4:00 a.m. to 7:59 a.m. (p=0.04), also sustained the association with higher odds of remaining at the facility. For patient age, those 95 or greater continued to be associated with high odds of remaining at the facility, but the previous associations were no longer shown. However, in this multi-variate analysis, for those aged 75-79, the odds of remaining at the facility were still 5.1 times the odds of the reference group, but in this analysis, the p-value improved to be statistically significant with a change from p=0.09 to p=0.03. Table 16.2. displays this refined multi-variate analysis.

Table 16.2

Odds Ratios	Remained at Facility	95% CI	P-Value
Total Patients (N=236			
Demographics			
Age Category			
80-84			
60-64	1.36	0.32-5.80	P=0.68
65-69	1.38	0.12-16.19	P=0.80
70-74	0.51	0.15-1.70	P=0.27
75-79	**5.1**	**1.14-22.88**	**P=0.03**
85-89	3.28	0.73-14.68	P=0.12
90-94	3.21	0.61-16.72	P=0.17
95+	**61.1**	**11.25-331.94**	**P=<0.0**
Telemedicine Dx			
Cardiology	**0.002**	**0.00-0.03**	**P=<0.0**
Neurology	0.25	0.04-1.76	P=0.17
Other	0.78	0.13-4.65	P=0.79
Pulmonary	**0.04**	**0.01-0.29**	**P=<0.0**
Time of Day			
12:00-3:59p			
00:00-3:59a	1.16	0.22-6.12	P=0.86
4:00-7:59a	**13.43**	**1.09-164.73**	**P=0.04**
8:00-11:59a	0.72	0.22-2.36	P=0.58
4:00-7:59p	1.41	0.38-5.23	P=0.61
8:00-11:59p	1.29	0.13-13.21	P=0.83

The telemedicine program components were each included in another multi-variate regression model to see how these factors influenced the odds of remaining at the facility. Keeping all other variables constant, Table 17. indicates that the odds of remaining at the facility decreased 91% for patients with video calls compared to those not receiving a video evaluation (p=<0.0). Lab testing also showed a strong association with the odds of remaining at the facility increasing by 7.4 times for patients that had a point of care test compared to those that did not have this testing as part of the telemedicine evaluation (p=<0.0).

Table 17.

Odds Ratios	Remained at Facility	95% CI	P-Value
Component	Yes (n=197)		
Video Call (n=27)	**0.09**	**0.03-0.27**	**P=0.00**
Lab (n=210)	**7.40**	**2.42-22.61**	**P=0.00**
Monitoring (n=185)	1.00	0.40-2.52	P=0.99
Medications (n=34)	0.57	.194-1.68	P=0.31

Two fit tests were conducted to ensure that the regression model with the telemedicine component variables was appropriate for estimating the odds of remaining at the facility. The Pearson's Chi Squared test yielded 9.85 (p=0.20) and a Hosmer-Lemeshow goodness of fit test resulted in 2.67 (p=0.26). This indicates that the multiple logistic regression model with the included variables suitably estimates the odds of remaining at the facility while adjusting for other factors.

Estimates of Cost Savings

Of the 236 uses of the comprehensive telemedicine program, there were 197 instances which resulted in the patient remaining at the facility. These observations were used to estimate the hospital variable cost savings for avoided utilization. This study does not include a clinical analysis of the likelihood that the patient would remain at the facility with or without the telemedicine program. For this reason, the cost savings estimate will include each of the 197 observations for which the patient remained at Lorien.

The UM UCH financial metrics, admission percentages and average length of stay calculations, are displayed in Table 18. First, the proportions of all UM UCH patients that receive care only within the ED (75.4%) was calculated using data from fiscal year 2015 and 2016. Nearly one quarter (24.6%) of the total patients that present at the UM UCH emergency room are admitted to the hospital. This includes patients in observation status and those "true" inpatient admissions. These two patient categories have distinct average lengths of stay for the time period of interest. These two variables help derive a patient "days avoided" calculation which is displayed below.

The UM UCH finance team derived the variable cost per day savings by accounting for portions of lab tests, imagining studies, and patient care hours per day consumed on average in a 24-hour period. The UM UCH hospitals generate the largest portion of this savings by adjusting the patient care ratios every four hours depending on patient volume. This means, for example, that a smaller unit census would result in some corresponding reduction in patient care personnel for the subsequent four-hour block. This is conceptually the same for the Emergency Department, but with a larger opportunity to reduce imaging and lab studies as opposed to human resources. This is due to the nature of the ED, which relies on these diagnostic options to determine the cause of the health issue, while the inpatient unit is more likely to focus on monitoring response to treatment.

Factoring the variable cost per hospital day, $450, an estimated savings of nearly $68,000 is achieved. When combined with the savings associated with patients that

remained in the Emergency Department before returning to Lorien, this estimate climbs to $87,000.

Table 18.

Patients Remaining at Facility = 197			
Percent Admissions from ED	24.60%	Percent Discharged from ED	75.40%
Estimated Patients	48	Estimated Patients	149
Observation Status (30%)	15	Variable ED Cost Savings/Visit ($128)	$ 19,013
Inpatient Status (70%)	34		
Average Length of Stay			
Observation (Days)	1.47		
Inpatient (Days)	3.82		
Days Avoided			
Observation	21		
Inpatient	130		
Estimated Cost Savings/Day ($450)			
Observation	$ 9,617		
Inpatient	$58,314		
Total	$67,932		

Total Estimated Variable Cost Savings = $86,944

In addition to the savings for hospitals, there are savings to be gained by the payers. As previously noted, the Global Budget Revenue system in Maryland can make it difficult to quantify the savings to payers, so this analysis estimates another large expense category that can be directly saved by payers- ambulance transfers. A 2007 report by the U.S. Government Accountability Office (GAO) in a 2007 report to Congress outlines the payments made by Medicare for ambulance transfers. (GAO 2007) Fee schedules for ambulance transfers can be impacted by the intensity of service, basic vs. advanced life support, or geographic considerations as outlined in federal regulations 42 CFR 414.610. (Cornell 2018) In the GAO report, the range for payment of these

transports was a low of $276 with a high of $464. To create an estimate for the savings associated with avoided ambulance transports, the payment associated with the majority of trips, more than 6,000, was used. This amount was $330.

The patients that are already at Lorien would require two ambulance transports, one bringing the patient to the hospital and the other for the return trip to the SNF. Therefor the savings can be calculated as the volume of patient transfers avoided (197) times 2 transports, times the cost per trip ($330). This would have saved all payers more than $130,000 during the pilot program. When adjusting this calculation for the payer-mix of patients that received telemedicine services, the savings to Medicare, $86,460, and Medicaid, $33,000, easily represent the largest beneficiaries of this savings.

Data Analysis Summary

This study analyzed data captured as part of a telemedicine pilot program at a continuing care facility in Bel Air, Maryland. Data were collected for the pilot site, Lorien Bel Air and a comparable facility 15 miles away, Lorien Bulle Rock. From a demographic perspective, the patient composition at each facility was similar in terms of age, gender, and payer status. Both sites were primarily comprised of Caucasian residents, but the Bulle Rock population included a greater proportion of African-American residents. Clinically, both locations admitted patients with similar medical conditions, although the Bel Air site showed a slight increase in its case mix index for admissions that originated at UM UCH. Patient transfer activity, a measure of quality and an important financial consideration under the Global Budget Revenue model,

decreased at Lorien Bel Air compared to the baseline period even when adjusting for resident days to create a rate of transfer.

A subset of patients that received telemedicine services was examined to better understand if patient and care characteristics were associated with different uses of the telemedicine system components. In this univariate analysis, there were significant associations with multiple patient and care characteristics. These included the patient bed type, LTC, and payer associations with receiving medications as part of the intervention. Additionally, clinical conditions upon admission or at the time of the telemedicine utilization showed associations with increased or decreased odds of receiving certain system components. Regarding care characteristics, there were three identified associations with telemedicine components including greater odds for receiving a lab on Saturday compared to the reference group and lower odds of the use of continuous monitoring for patients between 4 p.m. and 7:59 p.m. and 8:00 p.m. and 11:59 p.m. compared to the 12:00 p.m. -3:59 p.m. reference group.

Telemedicine program components were also analyzed to identify associations with hospital utilization. The univariate regressions showed statistically significant associations for the outcomes of interest: ED visits, readmissions, and remaining at the facility with the independent variables of video call and labs. Specifically, the odds of experiencing an ED visit or readmission increased if the patient had a video call. Further, in the multi-variate analysis, the odds of remaining at the facility decreased by 91% for patients that received a video call as part of the intervention.

Another key telemedicine component also was associated with readmissions and remaining at the facility. The odds of experiencing a readmission decreased by 91% for

patients that received a lab test, and those that remained at the facility were 13 times more likely to have received this component of the telemedicine program. In the unadjusted models, labs appear to serve as a strong factor in the ability of the Lorien team regarding understanding the medical issue and adjusting treatment to keep the patient in the facility.

Independent variables that showed association with the outcomes in the univariate analysis were included in the multiple regression models for patient and care characteristics. After completing a second analysis, the only remaining associations were for age, telemedicine diagnosis and time of day. Likewise, the telemedicine components were included in a multiple regression model with the outcome of interest: remained at facility. In this analysis, the association with video call and labs remained statistically significant. This includes a reduction in the odds of remaining at the facility for patients that received a video call and an increase in the odds of patients remaining at the facility if they received a lab test.

The final pair of analyses estimate the financial savings associated with keeping residents in place at the continuing care facility. Over a 24-month period, the hospital is estimated to have saved approximately $87,000 in variable cost avoided and the payers saved approximately $130,000 in avoided ambulance transportation claims, the largest portion of which was saved by Medicare and Medicaid (92% of total savings).

CHAPTER 5
DISCUSSION OF RESULTS AND POLICY IMPLICATIONS

Introduction

Telemedicine programs can play a vital role in the U.S. healthcare system's transition from volume-based to value-based care. Many key considerations await transformative leaders before launching a program. First, organizations must create an environment where clinicians in the hospital and those in the skilled facility can agree on the patient conditions that are best addressed remotely. Failure to create this agreement will lead to tension among providers who feel that the patient should or should not have been transferred. Payment reform is also vital to aligning the facilities and providers for this kind of patient evaluation. As of 2018, this type of program is only reimbursable in rural or medically underserved areas. Leaders must also incorporate the desires of the patients and families that can benefit from a program that adjusts treatments without another ambulance trip to the hospital, while minimizing the potential for bad outcomes. Proper selection of technologies, or failure to do so, will determine the buy-in that is garnered by the hospital-based providers and the nursing staff at the SNF. Finally, leaders must guard against resistance to transformative telemedicine programs-an innovation dilemma- that often occurs when multiple change programs disrupt the work of frontline teams.

Successful implementation of the technology and processes that provide the right care at the right time in the right location, require adaptive leadership and innovative thinking to align the necessary stakeholders in the change process. While there will

continue to be barriers associated with this type of innovation, successful leaders will find novel ways to align organizational cultures, incentivize value-added behaviors and break down the current silos of care.

Clinical Agreement between Acute Care and SNF Caregivers

Placing the care of the patient at the center of the change, leaders must find ways to promote agreement among providers across the care continuum, about the necessity for patient transfers for expensive hospital care and consider the safe alternatives available at the SNF. As much as 62% of SNF re-hospitalization is related to complications of the condition for which the patient was recently in the acute care setting (Dombrowski 2012). Further, CMS studies have revealed that 80% of the potentially avoidable cases from SNFs are related to just six clinical conditions: (1) pneumonia, (2) dehydration, (3) congestive heart failure, (4) urinary tract infection, (5) skin ulcers, and (6) chronic obstructive pulmonary disease/ asthma (CMS 5). Even with patient familiarity and a focus on these specific clinical conditions, clinicians at the acute care setting may disagree with the SNF care team about a transfer due to the timing of the identification of the issue, patient or family preference for transfer and/or the viability of alternatives to acute transfer (Lamb 2011). The hospital ED providers expressed discomfort with taking on the liability of clinical decision-making while being uncertain of the full capabilities of the SNF. This concern could be manifested in the likelihood of the ED provider initiating a transfer rather than recommending that the patient remain at the SNF and risk having the patient fail to get the appropriate treatment. The study showed that the odds of remaining at the facility decreased by 91% for patients that received a video

call. Interestingly, at a Lorien-MEMN-UM UCH case review session, an UM UCH ED provider stated that his decision to have the patient transferred was validated because the patient was admitted to the hospital for three days. A detailed case review however, showed that each of the treatments furnished to the admitted patient - intravenous medications and fluids and x-ray studies - were easily and consistently available at the SNF. In other words, there were appropriate alternatives available, yet the provider was not fully aware of the SNF capabilities, which led to disagreement about the categorization of the case as potentially avoidable.

Prior to the implementation of the Lorien-UM UCH program, providers collaboratively drafted inclusion/exclusion criteria to help govern the program. During the first several months of the program, these criteria were refined as providers' comfort with the system increased. However, it was not uncommon for a patient to narrowly avoid fitting into the amended inclusion criteria, which resulted in a transfer that some at the SNF thought was avoidable. In retrospect, it appears that a more formal agreement, beyond the clinical criteria, could have fostered better alignment among providers. These arrangements can help preplan for clinical circumstances when the patient doesn't precisely fit the telemedicine criteria but may benefit from one or more of the components. Providers could agree in advance, for example, that a patient with a low oxygen saturation level may use the system because these levels are consistent with the patient's baseline status. In the absence of this formal agreement, providers at the UM UCH may decline the telemedicine request and initiate the transfer process outright. Clinical Practice Agreements (CPAs) have been used previously to create the rules of engagement among different clinical stakeholders where there may otherwise have been

disagreement. Having this extra layer of legal formality could have helped providers work through patient challenges without an automatic default to requesting a transfer.

Payment Reform

As of 2018, payment alignment continues to be a barrier for wider adoption of the telemedicine programs. Katz notes, "Telemedicine may offer advantages in evaluating acute changes in condition that do not meet clear criteria for immediate transfer, but the savings from reduced hospitalizations do not necessarily accrue to the nursing home and physicians are not generally reimbursed for such activities." (Katz 2015) Future payment redesign under consideration by CMS may move hospital-SNF telemedicine programs from novel to norm. For Maryland, the change to a hospital Global Budget Revenue (GBR) reimbursement model in 2014 incentivized hospitals to prevent readmissions prior to discharge and after discharge by partnering with post-acute facilities. Medicare is slowly introducing value-based reimbursement for nursing homes to encourage greater accountability and collaboration with providers across the care continuum. CMS will develop a "risk-adjusted potentially avoidable hospital readmission rate…and apply incentives and penalties in October 1, 2019 to those facilities that have a risk-adjusted potentially avoidable hospital readmission rate above or below the benchmark" (Ouslander 2015). To fund these incentives, CMS will begin to withhold two percent of SNF payments beginning in October 2018 (AHCA 2014). This small percentage of risk for post-acute providers may be just the first step in a greater transition to value-based payments. In 2018, CMS proposed additional changes in the Medicare payment system to reward value and medical results. CMS Administrator Seema Verma notes that as

Medicare beneficiaries, "face rising healthcare costs in other clinical settings, we [CMS] need to leverage advances in technology that help to modernize our programs in a way that benefits patients." The proposal would create a "patient-driven payment model" that could save Medicare as much as $2 billion over ten years. (Beaton 2018) For patients, this means that a 20-60% reduction in hospitalizations from SNFs would eliminate between 77,000-260,000 hospitalizations annually. (Walsh 2012) This recognition by Medicare regarding embracing technology and aligning payment with valued behaviors is significant.

Another Congressional proposal is the Reducing Unnecessary Senior Hospitalizations Act of 2018, also known as the RUSH act. This legislation would take steps to promote broader adoption of telemedicine services by allowing for certain nonsurgical services to be provided at skilled nursing facilities instead of the hospital. These services could be provided using telehealth programs. The current language in the bill, however, does not specify how this service would be reimbursed or which services are even permitted. (Van Denmark 2018) As of January 2019, there is not an accompanying piece of legislation in the Senate which may lead to delays in approving this important instrument that promotes broader adoption of telemedicine.

Previous advancements in geriatric care have been developed with the context of the payment system at the forefront. The Coleman Care Transitions Interventions framework has allowed vulnerable patients to gain confidence in self-management and recognizing symptoms that may require medical attention. Interestingly, Coleman notes that,

> "…the intervention was specifically designed to be compatible within CMS capitated and fee-for-service payment systems. The financial incentives of capitated payment are well aligned to support an intervention designed to better integrate care across settings and reduce subsequent use of acute care services such as hospitalization." (Coleman 2004)

Maryland hospitals, operating under the pseudo-capitated GBR payment model have identified the need to integrate with non-hospital partners. Ouslander writes, "…telemedicine is a promising approach to both reducing unnecessary hospital transfers and the clinical workforce shortage." (Ouslander 2016) In the Evaluation of the Initiative to Reduce Avoidable Hospitalizations Among Nursing Facility Residents, CMS noted that the RAVEN project in Pennsylvania showed promise in reducing Medicare expenditures for all-cause hospitalizations. (CMS 2017b) Organizations operating in Maryland will be advantaged in fully leveraging the benefits of telemedicine because alignment between two of the three key clinical providers will occur in the coming years. The hospital GBR and SNF PDPM payments create alignment at the facility level. Yet, if the physician reimbursement schedules are not fully modernized, it will be incumbent on the hospital or nursing home to create funding that rewards value over volume. Nationally, hospitals that remain reliant on a fee-for-service payment model will have difficulty implementing such a program, even if their SNF providers are willing.

Patient Participation

In addition to the physician and facility, the patient and family perspective is paramount in the development of a comprehensive telemedicine program. The patient must understand the benefits and limitations of this type of evaluation as a primary consideration of treatment. At a basic level, the Lorien-UM UCH program provided education about telemedicine, and the types of conditions best suited for remote evaluation, during the SNF admission process. This allows the SNF to gather telemedicine consent while completing the formal consent to treat from the patient. Even with good education and communication about telemedicine, the patient may opt for a higher level of care when the SNF treatment has stalled or worsened. O'Malley posits that, "…the [nursing home] resident's preferences for hospitalization will be reflected, for example, in the presence of advance directives." (O'Malley 2011) The existence of a living will may help prevent unnecessary transfers by proactively delineating the expectations for future care, including services compatible for telemedicine. Under the duress of a changing clinical condition, patients and families may default to the position that an acute care transfer will provide a higher degree of clinical benefit, when it may only provide higher cost for the same treatment. The common belief is that hospital care is better than SNF care. However, even those most familiar with the U.S. healthcare system would arguably have difficulty in identifying the differences in treatment and costs that would change this attitude. While not formally evaluated in the study, families expressed their pleasure with the telemedicine program, which permitted continuing treatment in a single location. In one instance, the telemedicine consult enabled the progression of a palliative care treatment at the SNF and allowed time for the patient's

family to travel from out of state to spend time with the patient in the continuing care facility "home" prior to the patient expiring.

Information Technology

Although implementation of a comprehensive telemedicine program to reduce hospital utilization requires change management and leadership, there are significant technical barriers that must be addressed as well. Selection of hardware and software while connecting systems to secure networks takes time and input from end users. Collaboration from Information Technology teams at the hospital, the SNF and from vendors are critical to ensuring the disruption-free and secure transmission of information and video/audio throughout the encounter. The Lorien-UM UCH program deployed telemedicine technology originally developed and deployed in U.S. military applications, which required strict programming language to avoid threat of hacking. As this was among the first uses between hospitals and SNF partners, the hardware and software needed to be calibrated frequently to gain 100% reliability. In addition, there were occasions when the network connection failed at either the SNF or the hospital. In fact, the connection was even lost between facilities when a local contractor inadvertently cut through the fiber optic lines in front of the hospital. In a review of problems of health information and the impact on care delivery, Kim et al. summarize that staff identified hardware (29%), software (29%), and network connection (24%) issues as key challenges in health IT deployment (Kim 2017). For the MEMN providers, any of these issues became synonymous with "the LifeBot doesn't work." A full 71% of the studies on health IT found that staffing training on the system was also problematic. Failure to

prevent these challenges can create doubt about the effectiveness of these types of programs in the minds of providers, especially those who have not also been financially motivated to embrace this type of solution.

The LifeBot system included an integrated Electronic Medical Record (EMR) that captured dynamic vital signs as well as narrative information collected by the care giver at the SNF. The development of this EMR may have been supported by the military application but required hospital and SNF users to document in a second health information system. This created additional, non-value, work for both teams and led to resistance from the ED providers. Farah Magrabi and team observed that in as much as 20% of computer-related patient safety events, issues with transferring information were noted. (Magrabi 2010) These unintended consequences are not uncommon when implementing EMR systems in residential aged care homes in Australia as highlighted by Yu and his colleagues, "…[these] consequences were caused by the initial conditions, the nature of the EHR system and the way the system was implemented and used…" (Yu 2013).

The Lorien-UM UCH program was launched with a select few ED physicians covering the services, leading to frequent use and facility with the LifeBot. After a few months, the program was expanded so that any ED provider working on the shift could be called upon for a telemedicine consult. Due to the variable volume of the remote consults, it was possible that a provider received training and then went months without a "live" encounter. This lack of practice with the system created additional consternation

for some providers, which may have led to a transfer for a case that otherwise met criteria for telemedicine evaluation.

Design Thinking

To prevent these challenges, healthcare leaders must create a program that integrates with existing workflows while promoting consistent use to foster user comfort. Design Thinking is a multi-stage framework first developed by Dr. Teo Siang that enables innovators to solve problems with the needs of human users at the forefront. Beck and Berry note that this process can be especially helpful in the healthcare arena. "Reframing the healthcare challenge is needed. The capability to reframe problems distinguishes design thinking from its analytical problem-solving counterparts." (Beck 2015) The process, "begins with empathizing with the target user, and then follows a flowchart-like process to define a problem or opportunity, ideate possible solutions, and refine a solution through multiple iterations of lean prototyping and user testing." (Swift 2018). In the development of a telemedicine program, it should be noted that there are multiple end users- the patient and the clinicians on both ends of the video call. Design thinking would have healthcare leaders consider the needs of patients, nurses and providers to create a system that improves upon existing workflows while leaving patients highly satisfied with the encounter. Interestingly, the Lorien-UM UCH program started with the identification of the telemedicine technology, LifeBot, and then sought to draft the teams to create new workflows in support of an implementation. Dr. Albala Bober suggests in his research on the intersection of design thinking and physician training, "you have to think about the experience that anyone has who interacts with your

idea- a device or a process- before you can go about making anything." (Bober 2018). Design thinking is noteworthy on two levels in this study. First, some of the ED providers and SNF caregivers did not categorize SNF readmissions as problematic or avoidable, and secondly, the system was not designed with them in mind. The technology was designed for military users and "retrofitted" for this acute-subacute application. In retrospect, Lorien-UM UCH worked the opportunity backwards and may have achieved less than optimal results.

This situation ultimately led to two significant changes in the program from a process and technology perspective after the initial 24-month pilot ended. First, a change in the telemedicine technology from LifeBot to Curavi. The Curavi system was designed as part of the University of Pittsburgh Medical Center Health System project RAVEN specifically for this type of use. This tool simplified the documentation requirements and user interface so that it minimized the duplication of data entry and allowed those not in frequent call rotation to engage with the system easily. Secondly, the provider coverage model migrated from the ED providers to the hospitalist service. This change moved the coverage group back to a small set of providers that were also likely to have either cared for the patient during the previous acute hospitalization or acted in the role of attending provider if the patient was transferred back. This group of nurse practitioners seemed motivated to use the system and make alterations to treatment plans while keeping the patient in place at the SNF. One benefit of this new model is that the SNF can potentially directly admit an unavoidable transfer directly to the hospitalist service and by-pass the ED altogether.

Innovation Dilemma

Health care leaders face a significant dilemma when addressing quality problems. Dubbed the "Third Paradox of Innovation", Dr. Dixon-Woods writes that health systems are unable to "keep up" with innovation because a, "…cycle of renewal and reinvention creates ongoing organizational turbulence and may diminish organization and practitioner enthusiasm for improvement." (Dixon-Woods 2010) A telemedicine implementation that is considered the "flavor of the month" may not receive the full support of all stakeholders to ensure success. Leadership from both facilities viewed the program as an important step in a stronger partnership to improve longitudinal care. Healthcare systems have not always been so accepting of the benefits of nimble implementations that generate new learning.

> By thinking carefully and critically about when we should regard health systems reforms as 'clinical experiments' (and thus requiring the same level of evidence and oversight as other clinical interventions) and when we should regard reforms as a normal part of the continuous experimental learning required to improve healthcare, we remain alert to the possible impacts- both positive and negative- of innovation. (Dixon-Woods 2010)

Pushing organizations toward innovation remains a challenging and often elusive endeavor for healthcare leaders. Despite presumed safety in the continuation of the same work (i.e., "business as usual"), failure to act preemptively may increase the risk of poor clinical or financial performance for healthcare organizations. Italian philosopher Lucius

Annaeus Seneca noted, “Fortune is of sluggish growth, but ruin is rapid.” While he might not have been considering healthcare at the time, it is apt, nonetheless. Organizations that wait to act until all of the risks are properly addressed, may find it difficult to make the change when the change moves from a choice to a requirement. Martin Reeves and his colleagues at Boston Consulting Group found that preemptively transforming leads to periods of sustained positive financial performance. “The preemption premium is continuous: the higher the relative performance of a company when it initiates change, the higher its long-term relative performance. In other words, the earlier a transformation is initiated, the better.” (Reeves 29) Maintaining performance, by doing more of the same, fails to consider the changes occurring within the industry by regulation or by competitor and can lead to erosion of the bottom line. As Toyota Chief of Personnel Iwao Isomure once stated, “our current success is the best reason to change things.” (Kouzes 2012) It is possible that healthcare organizations can achieve great clinical gains over the long-term by preemptively embracing telemedicine programs that provide continuity in the care of patients throughout the continuum of care.

It is noteworthy that at the time that Lorien and UM UCH commenced the telemedicine program, clinical leaders in other medical specialties at UM UCH specifically declined during 2014-16 to explore telemedicine options for their practices. By the summer of 2017, however, infectious disease providers, followed by their colleagues in pulmonary medicine began to implement these programs in support of patients in Harford County. They found the systems easy to use, patients accepting of this type of evaluation, and that a “hospital as payer” model enabled care. In their experience,

this new approach was at least as good as the current standard and potentially better, because the clinical expertise could reach the patient earlier in the care process.

Overtime the technology has evolved to reduce the risk for leaders to enter this sector of care. Early in the pilot, Lorien and UM UCH deployed the LifeBot system -an expensive all-in-one system with proprietary software that required specialty software on each provider's laptop. Just four years later, the hospital is even using the Zoom app, a HIPAA compliant program that can be loaded on any provider or patient's smart phone for a small fee. On the one hand, UM UCH and Lorien could be judged as spending too much too early for a telemedicine program. On the other, this preemptive approach allowed the facilities to leverage four years of learnings when the technology became more of a common commodity.

Implications for Future Research / Strengths and Limitations

As the Maryland hospital payment system continues to evolve, this research demonstrates an innovative approach to reduce hospital utilization that originates in the skilled nursing setting. There are, however, some limitations that may prevent generalizing the findings to other States or health care environments. First, it must be acknowledged that the program was deployed under the Global Budget Revenue model in Maryland and that this type of telemedicine program is not reimbursable by Medicare as of 2018. The GBR incentivizes the hospital system to provide payment to the Physician group for each successfully completed telemedicine call because that cost is likely to be less than the expense associated with admitting the patient. In this model, the hospital assumes the role of the payer to MEMN for the service that is otherwise not reimbursed.

Under the current fee-for-service environment in other States, it may take longer for organizations to realize the value of this tradeoff.

The second limitation is that the 30-day readmission rate is not entirely within the control of the SNF or the hospital. The average length of stay at Lorien Bel Air is much shorter than 30 days. This is as much due to the medical needs of the patients as it is to the reimbursement model for this type of care. Medicare has a tiered coverage model for skilled nursing that includes $0 co-pay for benefit eligible patients for the first 20 days of skilled nursing services. Beginning on day 21, the beneficiary must pay $161 dollars of coinsurance for each day of service. Beyond day 100, the patient is responsible for all costs (CMS 2016). As a result of the coverage and their medical conditions, many patients are discharged from SNFs prior to day 21. Medicare patients that complete their skilled nursing care short of the 30-day readmission window and return home may qualify for or pay out-of-pocket for home-based services that are equally impactful on readmissions. Conversely, a patient may still be readmitted to the hospital having already been discharged from the SNF setting but within the 30-day window after the hospital discharge. The readmission rate may not be exclusively reflective of the telemedicine program between the SNF and the hospital.

Clinical necessity and patient selection may also serve as limitations for the study. During the pilot, there were occasions when the clinicians at UM UCH and Lorien disagreed about the patient's qualifications for using the telemedicine program. Fully understanding this disagreement would require significant analysis, and perhaps even concurrent examination of the use of the system and the resulting clinical decision. Also,

it is possible that patients received the telemedicine video call because they were sicker than patients that remained at the facility without the video call. That may have impacted the odds of remaining at the facility after remote evaluation. Understanding the implications of acuity on the telemedicine program components will require future analysis.

The study also has many strengths that could be generalized elsewhere. Based on the findings, the comprehensive telemedicine program will reduce unnecessary transfers to the hospital that result in expensive care. The numerous Accountable Care Organizations that are in operation, and progressive Medicare Advantage plans, many of which include health system investors, will find the expense savings of this program beneficial to managing the per capita costs of their assigned populations. Medicare, via new payment programs, will continue to push providers into quality-based reimbursement programs or advanced alternative payment models, such as the Bundled Payments for Care Improvement, that may find this type of telemedicine program a valuable component of a population health management bundle.

Another strength of the study methodology is that the data collected during the pilot account for key covariates such as time of day, day of week, and clinical condition. Associations between telemedicine and reduced hospitalization within certain subgroups may be critical for organizations looking to target this intervention at key times or for selected medical conditions. Although not statistically significant, this study identified differences in the patient status (SNF or LTC) that may impact the odds of remaining at the facility after the telemedicine episode. This may aid in a more deliberate and

incremental deployment of this program throughout Maryland and elsewhere. For example, a SNF that has a strong cardiac rehabilitation program may target the telemedicine deployment for Congestive Heart Failure (CHF) patients in an effort to attract additional admissions from ACOs or to remain as part of a preferred provider network.

Another strength is the duration of the pilot program which lasted 24 months in total. This allows for data analysis of telemedicine use throughout two years to account for some seasonal variation. Comparing data in the pilot month (and subsequent data collection period) to data from the same month in the baseline period also enabled trending to account for any seasonality with regard to the general patient population and the transfer rate. The reductions in the patient transfer rate, adjusted for patient days, in the pilot program occurred in both of the telemedicine program years.

Conclusions

Telemedicine programs can prevent expensive hospital utilization and lead to more comprehensive care for residents of continuing care facilities after an acute hospitalization. Beyond the video calling capability, these future programs necessitate the implementation of point of care testing to drive optimal clinical decisions in the post-acute setting even when the hospital provider is unavailable for the video call. Forging continuum-wide comprehensive telemedicine programs will require adaptive leadership from health system teams to overcome the known technological, cultural and payment model barriers to successful implementation. As the term innovation becomes overused and devalued within healthcare, Maarten Koomans describes innovation in terms of

value. “Value Innovation takes place when we combine our insights in the customer jobs to be done and evaluate them against [clinical] outcomes and possible reimbursements.” (Koomans 2017). To the great benefit of our patients, Lorien, MEMN, and UM UCH created a collective culture that improved the quality of care by identifying the patient’s clinical need--hospital provider evaluation or point of care test--while formulating a reimbursement model where one did not previously exist.

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CURRICULUM VITAE

Colin Ward was born on November 22, 1971 in Baltimore, Maryland. He grew up in Bel Air, Maryland, graduating from John Carroll School in 1990 before matriculating to Mount Saint Mary's College. After graduation from MSM in 1994, he worked in various broadcasting positions including WBAL-TV and WBAL-Radio as well as ESPN. He entered the Johns Hopkins University, Bloomberg School of Public Health MHS program in 2002, graduating in 2004 and winning the John P. Young Memorial Award.

Colin has held positions of increasing responsibility in the healthcare field during his employment with LifeBridge Health, Greater Baltimore Medical Center, and University of Maryland Upper Chesapeake Health. He also serves on key state-wide committees to advance the efficiency and effectiveness of the healthcare delivery system.

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Broadcast Director of the Ravens football games on the WBAL/ WIYY radio network

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Presentations:

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Panelist, "Patient Engagement in the Medicare Shared Savings Program," Medcity ENGAGE Conference, Washington, D.C., June 2013.

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